Scientific Center of Innovative Research

THE DEVELOPMENT OF INNOVATIONS AND FINANCIAL TECHNOLOGY IN THE DIGITAL ECONOMY

Monograph

2023

DOI: 10.36690/DIFTDE

International databases and directories indexing publications:
- CrossRef (DOI: 10.36690);
- Google Scholar;
- National Library of Estonia;
- The ESTER e-catalog;
- PKP-Index

The textbook is recommended for publication by the Scientific Committee of the OÜ Scientific Center of Innovative Research (protocol No. 4 dated May 31, 2023)

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ISBN 978-9916-9739-7-4

The development of innovations and financial technology in the digital economy: monograph. Pussi, Estonia. OÜ Scientific Center of Innovative Research. 2023. 230 p.

The monograph is the result of a multidisciplinary study of the problems of development of innovations and financial technology in the digital economy. In particular, the authors focused on the main definitions, structure and features of the digital economy. Particular attention was paid to innovations in the digital economy and digital competences, which are necessary for its development. Quite important attention of the authors of the study was focused on the development of financial technologies in the digital economy, including blockchain technologies. The main provisions of the study are focused on the formulation of new scientific hypotheses, methods and tools for the development of the digital economy. The publication is intended for scientists, civil servants, teachers and students of higher education institutions, practitioners, a wide range of readers who are interested in the problems of digital technologies and digital society.

ISBN 978-9916-9739-7-4

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INTRODUCTION

One of the main trends in the development of modern society is the penetration of information technologies into various spheres of human activity. Informatization is becoming such an important factor in increasing labor productivity and improving the quality of life that the changes taking place are considered by researchers as the onset of a new era of economic development, which is characterized in the literature by the term "digital economy".

Despite the large-scale research conducted by scientists and experts, the problems of the digital economy constantly arouse lively interest.

The first section "THE DIGITAL ECONOMY: DEFINITIONS, STRUCTURE AND FEATURES" examines the issue of modern trends in the development of innovations in the digital economy through the prism of the management of the economic security of the state; the main trends of the development of the digital economy in the EU countries; certain aspects of the post-war recovery of Ukraine's digital infrastructure; formation and development of digital competencies in the conditions of digitalization of society.

In the second section "THE DEVELOPMENT OF INNOVATIONS IN THE DIGITAL ECONOMY" the issue of prospects and threats of digitalization as an innovative factor of modern business development is investigated; management of innovative processes in the business environment in conditions of digitalization of the economy; organization and implementation of electronic document flow at enterprises as a way to digitize the information space of accounting and taxation; increasing the information and digital competence of teachers in the conditions of digitization of education.

The third section "THE DEVELOPMENT OF FINANCIAL TECHNOLOGY IN THE DIGITAL ECONOMY" examines the development of innovative business companies and the fintech industry in the digital economy; advantages and disadvantages of blockchain technology in the digital economy; the main trends in the development of blockchain technologies and the prospects of their use for fraud protection.

We hope that our monograph will help to take a comprehensive look at the problems and prospects of the development of the digital economy.

Editor-in-Chief,
Dr. Science (Economics), Professor
Mykola Denysenko

CHAPTER 1
THE DIGITAL ECONOMY: DEFINITIONS, STRUCTURE AND FEATURES

MANAGEMENT OF THE ECONOMIC SECURITY OF THE STATE: MODERN TRENDS IN THE DEVELOPMENT OF INNOVATIONS IN THE DIGITAL ECONOMY

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Citation:
Denysenko, M., Breus, S. (2023). Management of the economic security of the state: modern trends in the development of innovations in the digital economy. *The development of innovations and financial technology in the digital economy:* monograph. OÜ Scientific Center of Innovative Research. 2023. 230 p. PP. 6-22, https://doi.org/*10.36690/DIFTDE-2023-6-22*

Abstract. *The implementation of the digital economy, especially against the background of the full-scale invasion of Russia into Ukraine (when as a result of the actions of the aggressor, the domestic infrastructure was destroyed: civil, military, social, etc. and the economy suffered significant losses in the amount of at least 700 billion US dollars) is a factor that has a significant impact on the level of economic security of the state in all its components, such as: macroeconomic, financial, foreign economic, investment, scientific and technological, energy, production, demographic, social, food security. In this context, it is advisable to consider the digitalization of the economy through the prism of economic security, taking into account the feasibility of ensuring the sustainable development of the state, which is relevant, taking into account the need to take into account possible resources of various types when studying security as a category, the presence of which in sufficient quantity will allow to achieve such a state, according to which will be provided with an appropriate level of security in order to be able to counteract external and internal threats). Purpose consists in the study, substantiation and development of theoretical approaches to the in-depth study of the digital economy in the context of managing the economic security of the state in the conditions of its reconstruction in the post-war period for the transition of the state and its regions to sustainable development. During the research, a set of methods was used to achieve the goal and solve the tasks set in the work, which ensured the conceptual integrity of the research, in particular: historical and logical; monographic; theoretical generalization; analysis; synthesis; induction, deduction; comparative and statistical analysis; graphic; abstract and logical. Taking into account the modern realities of the functioning of the economy of Ukraine in order to ensure a sustainable trend of economic growth of the state and increase the level of its economic security in the context of its management, which is possible in particular due to the activation of the use of the innovative component of economic development for the transition of the state and its regions to sustainable development. The essence of the digital economy is considered, which, in turn, affects the level of economic security of the state in the context of its management and actualizes the need to consider the digital economy through the prism of its relationship with the economic security of the state, taking into account the innovative component of economic development - an important component of economic growth state. Special attention is paid to the research of the theory of innovations and the main factors affecting innovative activity and problems that lead to the slowdown of the economic growth of the state.*

Keywords: *digital economy, innovation, innovation triad, innovation theory, economic growth, economic security, paradigm, sustainable development.*

The digital economy can become an important prerequisite for ensuring and increasing the level of economic security, and in the future, an independent element of security. Taking into account the problems of the research, it should be noted that, according to The Good Country Index 2022 [3], Ukraine took first place among 169 countries in the category "Science and technology" in terms of the number of foreign students studying in the country (according to UNESCO) relative to the size economy (the top five countries also include Hungary (2nd place), Great Britain (3rd place), the Czech Republic (4th place) and Latvia (5th place).

In general, Ukraine positions itself as one of the largest global exporters of IT services, the revenue from which is about 5 billion dollars. for a year. 185,000 specialists work in the industry (in 2018), this figure increased to 220,000 in 2020. More than 4,000 technology companies work in Ukraine, of which 1,600 are involved in software development. 100 Fortune 500 companies are clients of the Ukrainian IT industry. 13 Ukrainian companies from the list have opened new offices around the world. This means that the image of a third world country is gradually changing, and we see a technological and strong Ukraine with the potential to take its place among the leading countries [4].

The mass introduction of information and software technologies, the creation of artificial intelligence, the emergence of cryptocurrency and blockchain, virtual reality, etc. - all this precedes the introduction into everyday life of such a phenomenon as the digital economy [5], contributes to increasing the technological, digital and even social level of development of society, which, in turn, it affects the level of economic security of the state in the context of its management and actualizes the need to consider the digital economy through the prism of its relationship with the economic security of the state, taking into account the innovative component of economic development - an important component of the economic growth of the state. The objective reasons for this are as follows: innovations are a basic element of an effective investment and innovation policy of the state; innovations are an important tool for creating and supporting competitive business entities and the state in the domestic and international markets of innovative

products; the role of higher education institutions in the development of national and European strategic ecosystems is important, in particular using the ASAP model (with components: human potential, effective administrative structures, adapted strategies) as a model of cooperation between academic and university science and business, which provides recommendations for raising the level interaction between them at the level of regions [6] for the transition of the state and its regions to sustainable development.

In general, it should be noted that the results of scientific research by many authors are fragmentary and do not contain tools for a comprehensive solution to the problem. Certain aspects were considered in the works of scientists, in particular, certain components of the research are related to the concept of management of separate spatial objects that form an ecosystem (such as cities and urban space) with the use of smart technologies (5G network, RFID transponders, cloud infrastructure, the Internet of Things as the main "disruptive" innovations that ensure an increase in the level of security through the control of possible risks and their prevention were considered in the works of the authors (Antonyuk I.V., Koshova S.P. [7], Pawlowicz B., Salach M. ., Trybus B., Roman K. [8-9]); analysis of the interrelationships between the development of innovative infrastructure and the processes of economic diversification with the corresponding development of recommendations to ensure favorable conditions for the development and functioning of effective innovative infrastructure (Kublikova T., Kuznetsova I. [10]). However, the generalization of the results of scientific work shows that they are reference points for achieving the research goal (such as: using the ASAP model (Hirsikoski A., Koski A., Prause G. [6]); focusing on the achievement of a short-term goal (improvement of security) does not contribute to the full recovery of the economy in the post-war period, to contribute to the formation of the so-called "reconstruction zones " in order to serve as a means of replacing foreign investments in order to avoid dependence on aid (Graciana Del Castillo [11]), use negative experience of partner relationships and the construction of an effective network innovation structure (Belderbos R., Gilsing V., Lokshin B., Carree M., Sastre, JF [12], (Fernandez-Esquinas M., Pinto H., Yruela MP, Pereira TS [13]), taking into account knowledge transfer flows during the

interaction of the university and industry in peripheral innovation systems [13], experience and capabilities of start-up projects (Mansoori Y., Karlsson T., Lundqvist M. [14]).

In modern conditions, innovations play a decisive role in the development of the world economy. The innovative nature of production is determined by the processes of constant introduction of new technologies and products, search for new ways of combining production factors. The consequence of such processes is a radical restructuring of the structure of the economy, a significant increase in the role of science-intensive industries in the functioning of the national and world economy.

Innovative processes in modern economic conditions ensure the development of productive forces and improvement of the system of industrial relations.

According to the theory of J. Schumpeter, who first introduced the term "innovation" into the scientific lexicon, it becomes the source of development and profit of both the enterprise and society as a whole. He considered innovation as a new function of production, "a new combination thereof" [15]. In the 60s of the XX century. J. Schumpeter defined the innovative "triad": "invention-innovation-diffusion", which was later transformed into an innovation chain: "research and development works (R&DKR) - invention-innovation diffusion-economic growth" [15-16].

There are many interpretations of the term "innovation", while it should be noted that most researchers do not distinguish between the concepts of "innovation" and "innovation". P. Lelon made an attempt to make a clear distinction between these concepts, who claimed that innovation is a new type of product, method, technology, and innovation is the introduction of innovation into the economic production cycle [17].

The modern methodology of the systematic description of innovations is based on international standards. To coordinate the collection, processing and analysis of information about science and innovation within the framework of the Organization for Economic Cooperation and Development, a group of experts developed a document called the "Frascati Guidelines" - this is "Proposed standard practice for the

examination of research and experimental development. The last edition of the "Frascati Guidelines" was adopted in 1993, it defines the main concepts related to scientific research and development, their composition and limits. The methodology for collecting data on technological innovation is based on the recommendations adopted in Oslo in 1992 and is called the "Oslo Guidelines". According to these international standards, innovation is defined as the final result of innovative activity, embodied in the form of a new or improved product or technological process, which is used in practical activities or in a new approach to social services [18]. A necessary sign of innovation is scientific and technical novelty and its industrial purpose.

The basis of the research of innovation theory is an attempt to identify the main factors that influence innovative development and to determine and thus measure the impact of each of them. He first noticed cyclical development in the middle of the 19th century. the Englishman H. Clark [18]when he drew attention to the gap of 54 years between two economic crises, but he could not determine the driving forces of this phenomenon. Later, this was addressed by K. Marx [18], who concluded that the basis of crises lies in the overaccumulation of capital. M. Tugan-Baranovsky [18], in particular, claimed that the cyclicality of economic development is determined by the limitation of loan capital and the peculiarities of its investment in capital goods. The beginning of the development of this theory was laid by M. Kondratiev, who is rightfully considered its founder, and managed to determine the impact of scientific and technical progress on the development of the world economy [19]. M. Kondratiev put forward a hypothesis about the mechanism of long cycles (big economic cycles), which he connected, in addition to price dynamics, to the process of capital accumulation, production growth rates, and the dynamics of innovations.

This concept was developed in the 1930s by the famous Austrian economist J. Schumpeter [14-15]. He emphasized that the main role in the mechanism of long cycles is played by innovations and fluctuations in the innovative activity of enterprises. Such an idea was proclaimed earlier (including van Gelderen and M. Kondratiev), but it was Schumpeter who put it at the center of his theory of long cycles and consistently developed it, he can rightly be considered the founder of

innovative theories of Western economists in the following period. One postulate of his innovation theory is also worthy of attention, that "the driving force of progress in the form of cyclical development is not any investment in production, but only investment in innovation" [20].

Until the beginning of the 20th century. most researchers assumed that there is one economic cycle in the economy - "industrial" or "business". The existence of this cycle (with a duration of 8-10 years) was first demonstrated by the French economist K. Zhuglyar in the middle of the 19th century. In the 20s of the XIX century. the thesis of the unity of the cycle has been questioned, both at the empirical and theoretical levels. American economist J. Kitchin demonstrated the presence of fluctuations in the American economy with an average duration of 3.5 years. Around the same time, M. Kondratiev empirically substantiated the existence of long fluctuations lasting about 50 years [21].

Declining rates of economic growth in the 1970s. stimulated the search for a connection between this phenomenon and long cycles. More and more attention began to be paid to the problem of unevenness of economic development over time, alternating periods of high and low rates of economic growth.

The concept of long cycles has played an important role in such a field of research as the role of scientific and technological progress (STP) in the economy. And it was the supporters of this concept, M. Kondratiev and J. Schumpeter, who first raised the question of the role of NTP in long-term economic development, and also drew attention to the problem of unevenness of technical progress (both in time and in economic space).

In the 40s and 50s of the XX century. the concept of economic growth came to the fore, within which NTP was considered as an important but sustainable factor of development. But already in the 60s of the XX century. the idea of non-uniformity of the NTP again gained some popularity, mainly thanks to the works of J. Shmukler. Finally, in the 70s and 80s of the XX century. in the writings of H. Mensch, K. Freeman, A. Kleinknecht and other supporters of the concept of long cycles, the idea of non-uniformity of the NTP took on a relatively complete form. It was in this area

that the greatest progress was made in the development of the theory of long cycles.

There are three possible approaches to solving the problem of measuring NTP and its contribution to economic growth. The first two approaches are related to the attempt of direct, and the third - indirect measurement of long-term fluctuations of NTP [21].

1. Patent statistics. These data allow, at least tentatively, to assess the flow of new knowledge, primarily practice-oriented. Comparing Great Britain and the USA, it can be noted that if general economic indicators had relatively stable temporal relationships, then the dynamics of issued patents in the 19th century. progressed almost in antiphase, and in the 20th century. - approximately synchronously (with a slight advance of Great Britain relative to the USA). Thus, patent statistics clearly do not indicate the presence of stable connections between long-term fluctuations in NTP and economic growth.

2. Statistics of innovations. Only 5 different registers of the most important innovations are known, while only three cover the 19th century, and all end in the 60s of the 20th century. All periods of peaks in the number of basic innovations (1820-1825, 1880-1889, 1930-1949) fall on the depression phases of the world's long cycle. However, the lists of the most important innovations are very conditional and there is no certainty that they were not shifted from the very beginning in favor of the a priori given scheme of the long cycle.

3. Aggregate factor productivity. Here we are talking about the estimation of the production function and the detection of fluctuations in the contribution of NTP to economic growth. Even R. Solow, in his work, which was devoted to the estimation of the production function in the period 1909-1949, noted that there is certain evidence that in 1909-1929 the growth rate of NTP was lower than in 1930-1949. In the work of Hartman and Wheeler, an attempt was made to estimate the long-term fluctuations of the NTP in Great Britain and the United States on the basis of two simple production functions. GNP at constant prices was used as indicators of output for the USA, GDP at constant prices and the volume of industrial production for Great Britain.

Technological complexity has conditioned the coexistence of sectors with different competitiveness in the economy of Ukraine. The competitiveness of industries and technologies for the production of consumer goods is low, however, on the other hand, Ukraine has significant scientific and technical potential in the defense-industrial complex and a number of other science-intensive industries. Therefore, it is important for Ukraine to make the most complete use of its economic potential based on an innovative economic development strategy [15].

In modern conditions, possession of high technologies is of strategic importance for the competitiveness of the countries of the world. Today, the world market for science-intensive products is estimated at 2.3-3 trillion dollars. USA. The process of knowledge-intensive production is provided by approximately 50 macro-technologies. Seven leading countries, which possess 46 macro technologies, control more than 80% of the market of science-intensive products: the USA receives 700 billion dollars from the export of these products. USA annually, Germany - 530, Japan - 400 billion dollars. USA respectively. Ukraine is one of the five countries that possess advanced aerospace technologies: it possesses 17 of the 22 basic technologies of the rocket and space sphere. The share of domestic science-intensive products in the world market of high-tech products is 0.05-0.1% [22].

Today, the signs of the 6th and 7th technological systems are becoming increasingly visible [23] - the 6th gives impetus to a new stage in the development of medicine and biotechnology, the 7th - to the creation of technologies of "cold thermonuclear fusion", which should fundamentally change the energy the potential of earthly civilization.

In the economy of Ukraine, the share of products of higher technological levels is [22]: 4% – for the 5th and 0.1% – for the 6th. GDP growth due to the introduction of new technologies in Ukraine is estimated at only 0.7%, while in developed countries this indicator reaches 60% and even 90%.

Table 1.1. The main factors affecting innovative activity

Groups of factors	Factors restraining innovative activity	Factors contributing to the implementation of innovative activities
Technical and economic	Lack of funding sources; weakness of the material, technical and scientific base; dominance of the interests of existing production; high economic risk; lack of demand for products; lack of information about markets; complication and increase in the price of scientific and research developments; low scientific and innovative potential of the state and regions	Availability of a reserve of financial and material and technical measures, as well as the necessary economic and scientific and technical infrastructure; development of competition and shortening of the life cycle of science-intensive goods; preservation of scientific and technical potential and state support for innovative activities
Organizational and managerial	Permanent organizational structures, excessive centralization, conservatism of hierarchical principles of organization construction, preference for vertical flows of information; organizational closed-mindedness, difficulties in inter-branch interactions; focus on established markets, focus on short-term payback; lack of scientific and innovative organizational structures; insufficient international scientific and technical cooperation	Flexibility of organizational structures, democratic style of management, advantage of horizontal flows of information; indicative planning, assumption of adjustments, decentralization, autonomy, formation of target problem groups; international scientific and technical cooperation; creation of innovative infrastructure (technology parks, business incubators)
Legal	The imperfection of the innovative base on the issues of innovative activity, protection of intellectual property	Legislative measures (special benefits, laws) that encourage innovative activity ensure intellectual property
Social and psychological	Resistance to changes that can cause such consequences as a change in status; the need for new activities, changing stereotypes of behavior, existing traditions; fear of uncertainty, fear of responsibility for a mistake; opposition to everything new that comes ("syndrome of someone else's invention"); low professional status of an innovator, lack of material incentives and conditions for creative work; the outflow of scientific personnel	Susceptibility to changes, innovations; moral reward, social recognition; the possibility of self-realization, the development of conditions for creative work, material incentives

Source: [18; 26-27]

The theory of acceleration, or, in other words, the theory of innovative entrepreneurship, also deserves special attention. It is also based, like most innovative theories, on the theory of long waves and is based on the development of entrepreneurship according to the US model, that is, it is associated with the Silicon Valley effect. It is known that only the USA focuses entirely on the pioneering type of innovation: most patents were developed there; on process innovations that

contribute to the rapid renewal of old branches of the economy and the emergence of new ones, in particular, the production of computers, office equipment, software development, cultural products (games, visual effects, etc.) [24].

The experience of the USA, according to the authors of innovation theories, in particular - the theory of acceleration, is a confirmation of the high connection between innovative activity and entrepreneurship, high return on investments in the innovation sphere [25]. Thus, it is possible to claim with full responsibility that innovation and technological leadership is the basis not only of the economic development of the country, but also the guarantee of its well-being in the future.

They can be considered a generalization of the factors of innovative development that have been studied for many years [18].

The following factors deserve special attention: state support for innovative activities and shortening the life cycle of science-intensive products.

The main problems that lead to a slowdown in innovative development of the state include [28, p. 13-14]:

1. The paradigm of "closed innovation", within which enterprises must generate their ideas, then develop and release corresponding products based on them. The concentration of the leading sectors of the economy on the model of "closed innovations" led to the emergence of critical situations at large enterprises and to the liquidation of some industrial enterprises.

2. Weak motivation for innovative activity in the real sector of Ukraine's economy. The problem of low economic demand for innovation is related to the lack of an effective state innovation policy and the state of competition in the country.

3. Emigration of leading specialists and scientists. Negative trends of "intellectual bleeding" of enterprises, institutions of higher education, scientific institutions through the emigration of specialists from Ukraine as a result of the influence of a number of negative factors, in particular such as: low innovation favorability of the industry of Ukraine, lack of cooperation, interconnected complexes of the production sphere and institutions of higher education, scientific institutions.

4. Absence of a competitive progressive system of training specialists from various branches of the economy and the possibility of realizing intellectual potential in Ukraine. One of the important conditions of innovative development is the presence of a progressive system of training specialists from various branches of the economy in institutions of higher education [29].

5. Weak systems of intellectual property protection and effective management. The experience of innovative development in leading countries shows the expediency of the legislative reflection of the procedure for obtaining patent rights by scientific institutions, the transfer of rights to the state in the event of their inefficient use.

6. Lack of mechanisms for stimulating and encouraging innovative activity. The commercialization of inventions in Ukraine does not take place at a rapid pace due to the insufficiently oriented tax system on innovative development, contradictions in legislation, etc.

In general, it can be stated that currently there is an urgent need to develop measures adequate to modern conditions for the support and development of the state on an innovative basis [29-33], which will provide an opportunity to ensure the economic growth of the state and increase the level of its economic security in the future. Technologies for working with data, such as blockchain technologies, artificial intelligence, authentication and identification technologies, mathematical modeling, will allow creating conditions for healthy competition, will create new forms of trade, mediation, and will become factors in the prevention, avoidance or mitigation of crisis situations. Technological directions based on previous concepts include the following:

- transition to robotic production, where an employee (person) controls and ensures the operation of the enterprise;

- transition to other sources of information storage with a high level of security ("cloud technologies");

- creation of a general information system, unification of production and management;

- transition to electronic media ("paperless technologies");

- the use of remote production control devices, with the possibility of monitoring (in particular, through mobile phones) [5].

Taking into account the above, it should be noted that digitalization of the economy is one of the tools that make it possible to achieve sustainable development.

In this context, it should be noted that ensuring sustainable economic development is possible on the condition of achieving a high level of competitiveness of the state's economy, its place in the market of high-tech products. Ukraine's place in it depends on its ability to compete with the world's leading countries in this field. The main condition for the dynamic development of Ukraine is to increase the competitiveness of its products, especially on the foreign market. But the position, in terms of competitiveness, in which our manufacturer is located, not only facilitates the penetration of imported consumer goods and high-tech products into the domestic market of Ukraine, but also leads to the atrophy of scientific and technical research and industrial branches of production. The biggest threat is the low competitiveness of the products of Ukrainian enterprises, which leads not only to a decrease in the main socio-economic indicators of the Ukrainian economy, but also to the so-called "system gap" from the group of leading countries due to the incompatibility of technologies, the low capacity of the economy for investments and innovations, as well as structural, sectoral and institutional incompatibility [34].

The most promising in modern conditions is the model of sustainable economic development. Its components include: socialization, state regulation, social responsibility, environmental friendliness, security, informatization, ownership, corporate system, market regulation, resource allocation, intellectualization, transnationalization. They act not only as static, but primarily as dynamic mechanisms of organization and functioning of the national, regional and world economy, the combination or mutual influence of which in a certain way allows to determine the content and structure of the model [35, p. 35]. History shows that in 2000 attempts were made to build an efficient economy in Ukraine. The Government developed an Action Program, which included a number of decisive steps. Among which the following were the main ones:

- reforming the system of state regulation: ending state interference in the direct activity of enterprises, removing regulatory obstacles to doing business;
- optimization of production due to systematic restructuring of the industry;
- increasing the competitiveness of products due to the reduction of production costs;
- structural restructuring of the machine-building complex and increasing the volume of production of science-intensive products;
- formation of closed and semi-closed technological cycles of production of final products.

However, until 2003, the Government's attempts were not successful, the same trend continues to this day, the reasons for which are mainly the significant restraining effect on Ukrainian exports of a complex of endogenous and exogenous factors, in particular the following [36]:

- low competitiveness of domestic industrial products;
- difficult financial condition of a large number of enterprises;
- insufficient development of domestic systems of certification and quality control of export products against the background of significant strengthening of requirements for consumer and environmental characteristics, as well as for the safety of products that are sold on the markets of industrially developed countries;
- lack of special knowledge and work experience in the field of export among most Ukrainian entrepreneurs, as well as insufficient coordination of their activities on foreign markets;
- Ukraine's global reliability rating for loans and investments is not high enough, which makes it difficult to use foreign financial resources to develop the country's export potential.

The listed trends indicate a gradual modification of the export structure in the direction of increasing the share of innovative goods. But these trends are still very weak and require comprehensive support from the state. "Therefore, the strategic task facing our state is to take a worthy place in the international division of labor for the production of high-tech industries" [37, p. 143].

Under the current conditions, when the initial shifts have already occurred, it is necessary to use all the chances as fully as possible to accelerate the reformation of the national industry and economy in general. The effectiveness of the further development of the export potential of the machine-building industry of Ukraine depends on its competitiveness, determined by the general industrial and innovation policy. And an important tool for achieving success in this matter is the national system of technological regulation, an important component of which is the state systems of standardization, metrology, licensing and certification of products, as well as quality control systems and compliance with mandatory standards.

In the conditions of intensifying international technological competition, the processes of cooperation and cooperation are becoming more and more widespread. The transformation of competition into coordination, and then into cooperation, reflects modern processes of informatization of society. In particular, one of the largest companies, General Motors, found it expedient to join forces with its competitor, Toyota. Joint ventures are one way of guaranteeing cooperation. Products and services are becoming increasingly knowledge-based and information-intensive. New products and services, as a rule, cover the entire portfolio of technologies, and not just one main one. Increasingly, firms that compete in the best way are those that find innovative ways to cooperate and cooperate, often even with the strongest rivals [38].

Determining the strategy for the development of competition involves taking into account a complex of factors, while the choice of such transformations that meet the tasks of ensuring the sustainable development of the state and increasing the level of its economic security becomes especially important. In particular, competitive policy should ensure the effective use of available resources, optimization of investment processes, acceleration of structural restructuring, implementation of scientific and technical progress, it should provide for the preservation and development of integrated industrial and economic complexes capable of producing products competitive on the global and domestic markets [39].

Taking into account the above, it is expedient to state that under modern

realities, in the conditions of war and in the post-war period, the importance of the implementation of the digital economy is beyond doubt. Its development will contribute to improving the quality of economic management at all levels and eradicating corruption in society. Consolidation and unification of efforts at different levels of management in this direction will contribute to increasing the level of economic security not only of individual elements of the socio-economic system, but also of the state as a whole and will contribute to the transition of the state and its regions to sustainable development.

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THE MAIN TRENDS OF THE DEVELOPMENT OF THE DIGITAL ECONOMY IN THE EU COUNTRIES

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Citation:
Mihus, I., Gupta, S.G. (2023). The main trends of the development of the digital economy in the eu countries. *The development of innovations and financial technology in the digital economy:* monograph. OÜ Scientific Center of Innovative Research. 2023. 230 p. PP. 23-41, https://doi.org/*10.36690/DIFTDE-2023-23-41*

Abstract. *The development of information technologies in recent decades requires active reforms in the digitization of all processes and the adaptation of the population to them from individual individuals, enterprises and organizations, as well as from states. Issues related to the emergence of potential threats to the economic security of the state attract special attention in this regard. The purpose of the research is to analyze the main trends in the development of industry 4.0 on an international scale and establish its impact on the economic security of the state by identifying potential threats to its development. The methodological basis of the study is the analysis of the results presented by the European Commission in its report "Digital Economy and Society Index (DESI)", which is developed annually to monitor the digital progress of member states. The article examines the features of the Fourth Industrial Revolution and Industry 4.0, which made it possible to clarify the main directions of the development of society: the formation of digital competences and the development of human capital; formation of digital infrastructure; integration of digital technologies in business and everyday life; improvement of digital public services. Finland, Denmark, the Netherlands and Sweden have the most developed digital economies in the EU, followed by Ireland, Malta and Spain. Romania, Bulgaria and Greece have the lowest DESI scores. Estonia, Finland, Malta and the Netherlands have the highest scores for digital public services in the DESI, while Romania and Greece have the lowest. The main results of the conducted research are the identification and systematization of potential threats to the economic security of the state, the occurrence of which can negatively affect its development. It was established that the main threats to the economic security of the state during Industry 4.0 are: the absence or insufficient level of digital competences; high cost of software development; non-acceptance of digital innovations by society; cyber attacks; sources of personal data; falsification of data, etc. A detailed study of the specified threats and their impact on the economic security of the state can become a direction of further research.*

Keywords: *digitalization of society, industry 4.0, economic security of the state, threats.*

In recent years, information technologies have played a significant role in the life of every person, and therefore are directly related not only to his personal life, but also to his work, financial calculations, security, etc. A significant surge in the development of information technology occurred during the COVID-19 pandemic, during which most workers performed their work separately, and most enterprises were forced to change their business processes taking into account the demands of the times.

It was during the pandemic that the most urgent issues for all enterprises became the improvement of digital skills of personnel and digitalization of business processes.

The digital economy and digital competitiveness are among the most commonly used terms referring to the socio-economic development perspectives of contemporary society. In a broader sense, the digital economy describes the development of a technological society and implies the widespread use of ICTs in all spheres of human activity. ICTs enable people to perform ordinary tasks more efficiently and have emerged as a response to societal needs (Sendlhofer & Lernborg, 2018). In addition to the impact on individuals, ICTs also have an important impact on companies, since they provide new opportunities for companies and facilitate the worldwide availability of their products and services (Elia et al., 2016). ICTs have contributed to transforming the nature and handling of the uncertainties typical for the entrepreneurial process and its outcomes (Nambisan, 2017).

The advantages of applying ICTs in companies are numerous (Rossato & Castellani, 2020): improved efficiency and effectiveness of business processes, improved understanding of user experience, increased creation and transfer of knowledge, increased awareness of the cultural value of the company's heritage, and the development of state-of-the-art employee skills. The advent of the digital economy was facilitated by the digital revolution, also known as digitalization, which represents a transition from analogue or physical technologies to digital data systems (Dufva & Dufva, 2019). Carlsson (2004) states that digitalization of information, combined with the Internet, creates a wide range of various combinations of

information and knowledge use through which the application of modern technologies and the availability of greater technical possibilities can be turned into economic possibilities. The Internet of Everything, aided by economies of scale and platforms such as consumer electronics, mobile devices, and urban infrastructure, enable the wide availability of services to consumers as well as easier access to potential consumers (Leviäkangas, 2016).

The relationship between ICTs and economic growth is an issue of particular interest in terms of both theory and practice. There are two prevailing understandings about the impact of ICTs application on economic growth (Thompson Jr & Garbacz, 2011): direct impact, which implies productivity improvements resulting from the application of ICTs, and indirect impact, which means the materialization of externalities resulting from the application and development of ICT. Several studies have reported a positive link between the development and implementation of ICTs and economic growth (Myovella et al., (2020). Portillo et al., 2020; Vu et al., 2020; Bahrini & Qaffas, 2019; Nair et al., 2020). Evidence indicates that ICTs improve various aspects of productivity (Skorupinska & Torrent-Sellens, 2017; Corrado et al., 2017; Pieri et al., 2018; Kılıçaslan et al., 2017, Ivanović-Đukić, et al., 2019; Haller & Lyons, 2019;). The digitalization and digital economy contribute to productivity growth in many ways (Wyckoff, 2016): by creating new innovative businesses and reducing the number of businesses with outdated, non-innovative operations; enabling smarter, more efficient use of labour and capital to create so-called multifactor productivity growth through which even older firms can improve; introducing new opportunities and services for individuals previously removed from the global economy (such as farmers and local producers); and enhancing the efficiency of inventory management and shipping.

Examining the impact of ICTs on economic growth is of great importance to policymakers, as it provides them with guidance for creating development strategies. Nevertheless, it should be borne in mind that a large number of indicators of digital development and competitiveness exist, and that most research uses only some of these as proxies, thus all aspects of digital competitiveness have not been covered.

The following are most commonly used as proxies in the literature: mobile and fixed broadband (Thompson Jr & Garbacz, 2011), broadband speed (Mayer et al., 2020), fixed and mobile phone subscriptions (Albiman & Sulong, 2017), and digital subscriber line broadband services (Haller & Lyons, 2019), investments in ICT (Niebel, 2018). For a detailed overview of digital development proxies, see Vu et al. (2020).

Measuring and comparing countries based on digital competitiveness is a topical issue, where several methodologies for quantification have been proposed. World Economic Forum has offered the Networked Readiness Index (NRI) for measuring the propensity of a country to take advantage of the opportunities offered by ICTs (NRI, 2019).

This index measures the performance of economies in using ICTs to boost competitiveness, innovation and well-being. Another methodology is the Digital Economy and Society Index (DESI, 2019) developed by the European Commission. It is a complex index that summarizes relevant indicators on European digital performance and tracks the development of EU Member States in digital competitiveness. In 2017 the DECA (Digital Economy Country Assessment) program was developed and tested (Ashmarina et al., 2020). DECA is a multivariate model that involves analysing the readiness, use and impact of digital transformation on national socio-economic progress. The DECA methodology is focused on assessing the current level of development of the digital economy to identify critical shortcomings, challenges and opportunities for future growth, as well as areas that require more careful analysis.

The United Nations International Telecommunication Union published the ICT Development Index (IDI, 2018) aimed at comparing and monitoring the development of ICT between countries and over time. E-government Development Index (EGDI, 2021) was developed to examine the development of e-government in the member states of the United Nations. Additionally, several authors have proposed composite indices of digitalization and digital competitiveness (Yoo et al., 2018; Milenkovic et al., 2016; Nair et al., 2020; Ali et al., 2020a; Ali et al., 2020b).

The construction of composite indices has specific critical steps on which the whole process depends and which are primarily related to the determination of appropriate weighting and aggregation methods (Saisana & Tarantola, 2002). When it comes to weighting methods when constructing composite indices, they can be grouped into three main categories (El Gibari et al., 2019): equal weighting, data-based methods, and participation-based methods. The equal weighting method has the least computational complexity but has drawbacks reflected in the loss of information (Nardo et al., 2005). The participation-based methods incorporate intuition, the subjective system of values and knowledge of the decision-maker or group, which is also a disadvantage of this approach because the weighting coefficients depend on their subjective assessment and perception. The data-based methods perform criteria weights determination based on data from the decision matrix, which eliminates the subjectivity of decision-makers, and weight determination is performed using mathematical and statistical methods based on information from the model. Yet, despite the apparent shortcomings, most of the stated indices of digital competitiveness use equal weights when determining weights (Pérez-Castro et al., 2021). When it comes to aggregation methods, criteria can be aggregated into a composite index in several ways: linear aggregation, geometric aggregation or multicriteria analysis. Each method implies different assumptions and has specific consequences (Nardo, 2005). Still, it should be noted that one of the advantages of multicriteria analysis methods is that the application of these methods leads to the creation of composite indices that are non-compensatory or partially compensatory.

The need to create an adequate composite measure for assessing and monitoring the digital competitiveness of countries stems from the fact that accelerated technological development imposes the urge to make effective strategic decisions related to the digital future, as well as to assess the level of digital development and competitiveness of countries (Alam et al., 2018). Having in mind the diversity and variety of indicators, it is desirable to create a unique composite indicator of digital development and competitiveness that will include various aspects of digitalization.

The digital economy and digital competitiveness have a multidimensional nature and can be defined as a multiple-criteria phenomenon (Balcerzak & Bernard, 2017).

Each country of the world responded differently to the challenges of Industry 4.0 in the field of public administration and self-government, which in some places contributed to the faster development of the digital society in all areas, including health care and education. Without a doubt, it can be stated that such transformations directly affected the economic security of all countries of the world.

Investigating the main trends in the development of industry 4.0, we consider it necessary to establish the main features of previous industrial revolutions. Thus, the first began at the end of the VIIIX century. with the increased use of steam and water energy and led to the transition from manual production methods to machines (i.e. mechanization); the second began at the end of the 19th century with the increase in the use of electrical energy, which allowed mass production (i.e. intensive use of electricity); during the third, they began to use electronics and Internet technologies of the 1970s and automated production (i.e. digitalization) [1–9].

Market development, internationalization and increased competitiveness have led to the emergence of the so-called Fourth Industrial Revolution and parallel development as the concept of Industry 4.0, which is based on the development of fully automated and intelligent production capable of autonomously communicating with the main corporate players [10].

Industry 4.0 is based on the horizontal and vertical integration of production systems driven by real-time data exchange and flexible production to ensure customized production [11, 12].

The fourth industrial revolution will lead to full automation and digitization of processes, as well as the use of electronics and information technology (IT) in production and services in the private environment [13].

The McKinsey Global Institute defines the Fourth Industrial Revolution as the era of "cyber-physical systems"—systems that combine computing, networking, and physical processes and contain a host of technologies that include mobile devices, the

Internet of Things (IoT), artificial intelligence (AI), robotics, cyber security and 3D printing [14].

Therefore, "the consequences of the development of technologies such as 3D printing, online sales services such as car services, medical examinations from home, ordering food sent directly from the store to the refrigerator, and so on, will have a significant impact on the changes in small and medium-sized enterprises (SMEs)" [12, p. 2].

According to the visionary work of Schwab (Schwab), the Fourth Industrial Revolution is developing exponentially, not linearly, which not only changes "what" and "how" to do things, but also "who" we are [15].

The introduction of Industry 4.0 has brought and will continue to bring profound changes to the global economy in terms of variables such as investment, consumption, growth, employment, trade, security, and more.

Growth and employment are certainly the areas most affected by the introduction of innovations related to the Industry 4.0 domain [15].

It is interesting that Rüßmann M., Lorenz M. and others. [16], analyzing the German context, proposed the expected growth at different levels with the application of innovations related to Industry 4.0. According to the authors, the transformation should lead to improvements and important increases in productivity (manufacturing sectors by 90-150 billion), income growth (about 30 billion per year), employment (6 percent growth over the next ten years), and investment (about 250 billion over the next ten years).

The term Industry 4.0 was coined in Germany and first used in 2011 to define a new proposal for future German economic policy; it was based on high-tech strategies [17].

This is not surprising, as the highest level of Industry 4.0 implementation can be seen in Germany, especially in international technology corporations. Companies such as Siemens, General Electric and Mitsubishi already have a wide range of manufacturing and automation solutions. "Manufacturing and automation technology developers such as DMG Mori, Wittenstein, Bosch, Rockwell, Omron, Schneider,

Stäubli, Yaskawa, Krones, PSI and Software AG are already selling many technologies and solutions as Industry 4.0" [18, p. 195].

Since 2011, the term has been widely used not only in Germany and in the field of engineering, where it was first introduced, but also in the fields of economics and management. Indeed, it radically changes the way firms are structured and, above all, managed. However, despite the fact that some articles have been published, primarily in the management literature, the academic discussion about Industry 4.0, the analysis of its content and its detailed description, as well as the explanation of its possible future developments deserve more attention [19].

So, for example, Pan M. (Pan M.) and others. claim that "Industry 4.0 represents the ability of industrial components to communicate with each other" [19, p. 1537]. At the same time, Kovacs J. and Kot S. (Kovacs, G.; Kot, S.) claim that "the essence of the concept of Industry 4.0 is the implementation of networked intelligent systems that realize self-regulated production: people, machines, equipment and products will communicate with each other one" [20, p. 122].

To date, significant scientific developments in the field of management have been published, which study the main changes in business management models and the main components of firms. Thus, the academic discussion about Industry 4.0, the analysis of its content and detailed description, as well as the explanation of its possible future developments [21-27] deserve the greatest attention.

Given that in the global dimension we are at the initial stage of digitalization of the economy, the very concept of the digital economy and some other related economic terms do not have generally accepted definitions. There is a large number of interpretations and interpretations of this term in various literature sources and analytical reports. This situation is due to the relative novelty of this topic and the lack of sufficient understanding of the phenomena of the digital economy, and the high speed of technological progress. That is, the time required to harmonize and standardize certain definitions lags behind the speed of technological change. Since the first mention in the mid-90s of the last century, the definition of the digital

economy has changed significantly, due to the rapid development of technologies and their integration into various socioeconomic spheres (Barefoot et al., [7]).

In the late 1990s, studies of the digital economy were mainly related to the development of the Internet and its impact on economic indicators and phenomena, so the concept of "Internet economy" (Brynjolfsson and Kahin, 2002[8] ; Tapscott, 1996 [9]). With the expansion of the possibilities and areas of implementation of Internet technologies since the mid-2000s, scientists have shifted the focus of their research to the conditions under which the Internet economy can develop and grow. The evolution of the definition and concept of the digital economy has been based on research on various policies to support the introduction of digital technologies, on the one hand, and the growing use of information and communication and digital technologies in business, on the other (OECD, 2012 [10] and 2014 [11]). With the improvement of the quality and volume of Internet connection in developing countries and the expansion of the range of digital products and services, the subject of digital economy research is a detailed analysis of the level of digitalization in developing countries (UNCTAD, 2017 [12]; World Bank, 2016 [13]).

Over the past few years, the debate has shifted again, focusing more on the dissemination of digital technologies, services, products, and skills in different economies. This process is often referred to as digitalization, which is defined as the transformation of a business through the introduction of digital technologies, products, and services (Brennen and Kreiss, 2014 [14]). The study by Malecki & Moriset (2007) emphasizes that digital goods and services contribute to faster change in different sectors, not limited to high-tech sectors, as previously thought (Malecki and Moriset, 2007 [15]).

Reflecting these changes, the reports of international organizations and analytical studies reveal the essence of "digitalization" and "digital transformation", i.e. how digital technologies change traditional sectors to further study various intersectoral trends in digitalization (OECD, 2016 [16] and 2017 [17] ; UNCTAD, 2017). These studies are particularly relevant for developing countries, as the digital economy is actively transforming traditional sectors such as agriculture, tourism,

transport, and more. Researchers have concluded that the most important economic changes may well be due to the digitalization of traditional sectors of the economy, rather than the emergence of new sectors with digital support. Important for the development of the digital economy and awareness of the consequences of its active penetration into the economy is the study of investment and public policy in the field of digital technologies and infrastructure. Equally important is the assessment of the development of the digital economy through its components. For example, the UNCTAD report (2017) notes that the development of the digital economy may be associated with the increased use of advanced technologies such as robotics, artificial intelligence, the Internet of Things (IoT), cloud computing, big data analysis, and three-dimensional (3D) printing.

Besides, compatible systems and digital platforms are important elements of the digital economy. There is an opinion of certain scientists (Brynjolfsson & Kahin 2000 [18], Bahl 2016 [19]) that the digitalization of the economy is a major driver of economic growth and has significant regional implications for business, employment, and society as a whole. This trend is especially true in developing countries, Dahlman et al. (2016 [20]) believe that digitalization in this case will accelerate economic growth, increase return on capital and productivity, reduce transaction costs and facilitate access to world markets. According to the WEF (2015 [21]), the digital economy is growing by 15-25% per year in emerging markets. To this date, some positive economic effects of digitalization can already be observed: global income convergence through wage increases in the digital sector (Beerepoot & Lambregts 2015 [22]); creating new, unique local markets for digital startups in developing countries (Quinones et al. 2015 [23]); global digital platforms that can be an effective alternative to corrupt markets and inefficient labor market institutions (Lehdonvirta 2016 [24]).

However, along with the positive developments, there are several challenges and obstacles to the digitalization of developing economies, primarily due to the low level of digital skills and technology (Dahlman et al. 2016). Also, Murphy & Carmody (2015 [25]) emphasize the existence of a potential risk of negative consequences

from the development of digital technologies due to limited resources, capabilities, institutional support, etc.; Foster & Heeks (2010 [26]) note the specific volatility of digital enterprises in developing countries; while Martin (2016 [27]) warns of the possibility of marginalization of workers in developing countries. Some researchers note that in addition to the positive effects, the digitalization of the economy in developing countries can lead to undesirable consequences, especially concerning information security and confidentiality (Manyika et al. 2013 [28]) and so-called premature deindustrialization in developing countries (Dahlman et al. 2016, Rodrik 2016 [29]). The development of the digital economy is closely linked to the introduction of digital and information technologies in related fields, such as software-oriented technologies such as blockchain, data analysis, and artificial intelligence.

The introduction of the latest technologies varies from user oriented devices (computers and smartphones) to 3D printers, wireless devices, and specialized hardware of machines and equipment, such as the Internet of Things (IoT), automation, robotics, and cloud computing. The Internet of Things (IoT) is also widely used, including in energy meters, to mark RFID goods for production, in animal husbandry, in logistics (Vostriakova, 2021 [30]), for monitoring of soil and weather conditions in agriculture, in renewable energy (Lezhniuk, 2020 [31]). Rapid progress in the combination of these technologies contributes to capacity growth and a significant reduction in data storage, processing, and transmission costs. A detailed description and analysis of some recent trends and prospects for the development of these technologies are grouped in Table 1.2.

Recently, in the writings of scientists, more and more attention is paid to the issue of the development of industry 4.0 and its impact on the economic activity of individual countries and the world as a whole. Unfortunately, insufficient attention has been paid to the issue of the impact of Industry 4.0 on the economic security of states, which allows us to outline directions for further research.

The purpose of the study is to analyze the main trends in the development of industry 4.0 on an international scale and establish its impact on the economic security of the state by identifying potential threats to its development.

The methodological basis of the study is the analysis of the results presented by the European Commission in its report "Digital Economy and Society Index (DESI)", which is developed annually to monitor the digital progress of member states.

Talbe 1.2. Trends in the development of digital technologies

Name	The essence and prospects of development	Leaders of implementation
Blockchain technology	According to the forecast of the value of Gartner business chains, after the first phase of growth in 2018-2021, in 2022-2026, investment flows are projected to increase, and new successful models to be created, which is expected to increase them by more than 3 trillion. dollars USA. worldwide (WTO, 2018 [32]).	USA, China
Three-dimensional printing	Further development of three-dimensional (3D) printing has the potential to disrupt production processes, stimulating international trade in design rather than finished products. Developing countries will have to jump over traditional production processes.	USA, China, Japan, Germany, Great Britain
Internet of Things (IoT)	In 2018, more "things" (8.6 billion) were connected to the Internet than people (5.7 billion), and the number of IoT connections is projected to grow by 17% per year and exceed 22 billion by 2024 (Ericsson, 2018 [34])	USA, China, Japan, Germany, Republic of Korea, France and Great Britain
5G networks	5G networks can process approximately 1000 times more data than modern systems (Afolabi et al., 2018 [35]). In 2019, 72 mobile operators tested 5G, it is expected (Deloitte, 2019 [36]), that larger-scale implementation will begin only in 2025.	USA, Europe and AsiaPacific
Cloud computing	Cloud computing is transforming traditional business models by reducing the need for its own IT professionals, offering flexibility to scale and consistently deploy and maintain programs (UNCTAD, 2013 [37]).	North America, AsiaPacific, Western Europe
Automation and robotics	According to the International Federation of Robotics (2018 [38]), global sales of industrial robots doubled between 2013 and 2017. This trend will continue, and sales are expected to increase from 381,300 units in 2017 to 630,000 units by 2021.	China, Japan, the Republic of Korea, the United States and Germany
Artificial intelligence (AI) and data analysis	General-purpose AI technologies have the potential to increase the global economy by about $ 13 trillion by 2030, which will contribute an additional 1.2 percent to annual GDP growth (ITU, 2018 [39]).	China, USA and Japan

Source: compiled by the authors

Since 2014, the European Commission has been monitoring the progress of member states in the field of digital technologies and publishing annual reports of the Digital Economy and Society Index (DESI) [27].

Each year, the reports include country profiles to help Member States identify priority areas for action, as well as thematic sections providing EU-level analysis in key digital policy areas.

DESI 2020 discussed increasing the use of digital solutions during the COVID-19 pandemic. This trend towards greater digitization is confirmed by the slightly higher growth rate of digital adoption by both citizens and businesses at the EU level.

Overall, the pandemic is estimated to have accelerated existing trends in global remote work, e-commerce and automation, and exacerbated labor mobility. However, these trends did not affect citizens and businesses equally. The results suggest that the large expansion of telecommuting following the COVID-19 outbreak has been heavily skewed toward high-paying white-collar jobs. This reflects differences in the structure of employment, where only 33 to 44% of jobs structurally allow telecommuting.

Businesses provided more fully digitized products and services: 34% before the Covid-19 crisis and 50% during the pandemic; and bought more cloud computing services: 24% before the pandemic in 2019 and 41% in 2021.

Significant differences continue to exist between large enterprises and SMEs, with 72% of large enterprises subscribing to cloud computing services compared to 40% of SMEs.

The DESI 2022 results show that while most Member States are making progress in digital transformation, business adoption of key digital technologies such as artificial intelligence and big data remains low, even among EU leaders. Inadequate digital skills are hampering future growth prospects, widening the digital divide and increasing the risks of digital exclusion as more services, including the most essential ones, move online. Efforts must be intensified to ensure the full deployment of the ubiquitous communications infrastructure (including 5G) required for highly innovative services and applications.

Finland, Denmark, the Netherlands and Sweden continue to be EU leaders in the implementation of Industry 4.0 for several years in a row, but in 2022 it was found that digital challenges remain inherent in most leaders as well.

In 2021, only 55% of small and medium-sized enterprises (SMEs) have achieved at least a basic level of digital adoption. Sweden and Finland have the most digitized SMEs (86% and 82% have a basic level of digital intensity, respectively), while Romania and Bulgaria have the lowest SME digitization rates. To achieve the Digital Decade target, at least 90% of small and medium-sized enterprises in the EU must have a basic level of digital intensity by 2030.

Businesses are becoming more and more digital, but the use of advanced digital technologies remains low. While 34% of enterprises already rely on cloud computing (in 2021), only 8% will use artificial intelligence (AI) in 2021 and 14% will use big data in 2020. According to the "Pathway to the Digital Decade" proposal, at least 75% of companies should move to AI, cloud and big data technologies by 2030.

There is a significant gap between large companies and small and medium-sized enterprises not only in the use of advanced technology, but also in basic digital solutions such as an enterprise resource planning (ERP) software package and e-commerce engagement.

Digital Public Services DESI tracks online public services by assessing member countries on whether each step of key services can be delivered fully online. In 2021, quality scores reached 75 out of 100 for digital government services for citizens and 82 out of 100 for businesses.

Estonia, Finland, Malta and the Netherlands have the highest scores for digital public services in the DESI, while Romania and Greece have the lowest. The developed strategy "Road to the Digital Decade" set the goal that by 2030 all key public services for citizens and businesses should be fully online.

In Fig. 1.1 below shows the progress of member states in terms of the overall level of digitization of their economy and society over the past 5 years.

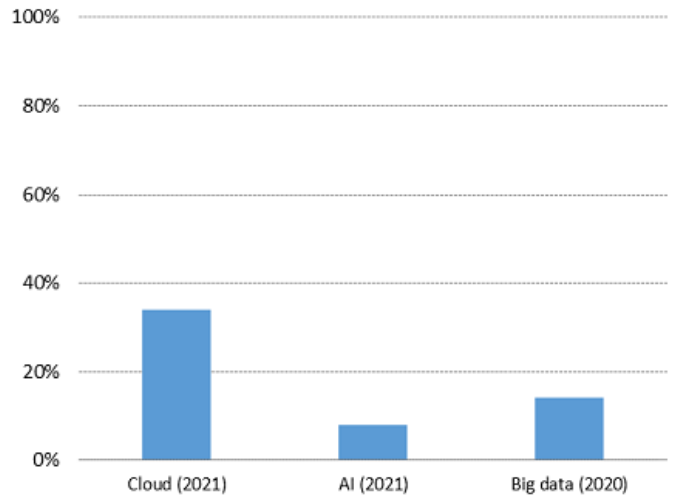

Figure 1.1. Adoption of advanced technologies (% of enterprises) in the EU, 2020/2021

Source: Eurostat, European Union survey on the use of ICT and e-commerce in enterprises [28]

Finland, Denmark and Sweden have the highest positions in the digital transformation of business.

In Fig. 1.2 presents the results of the Digital Economy and Society Index and the relative progress of member states in the period 2017-2022.

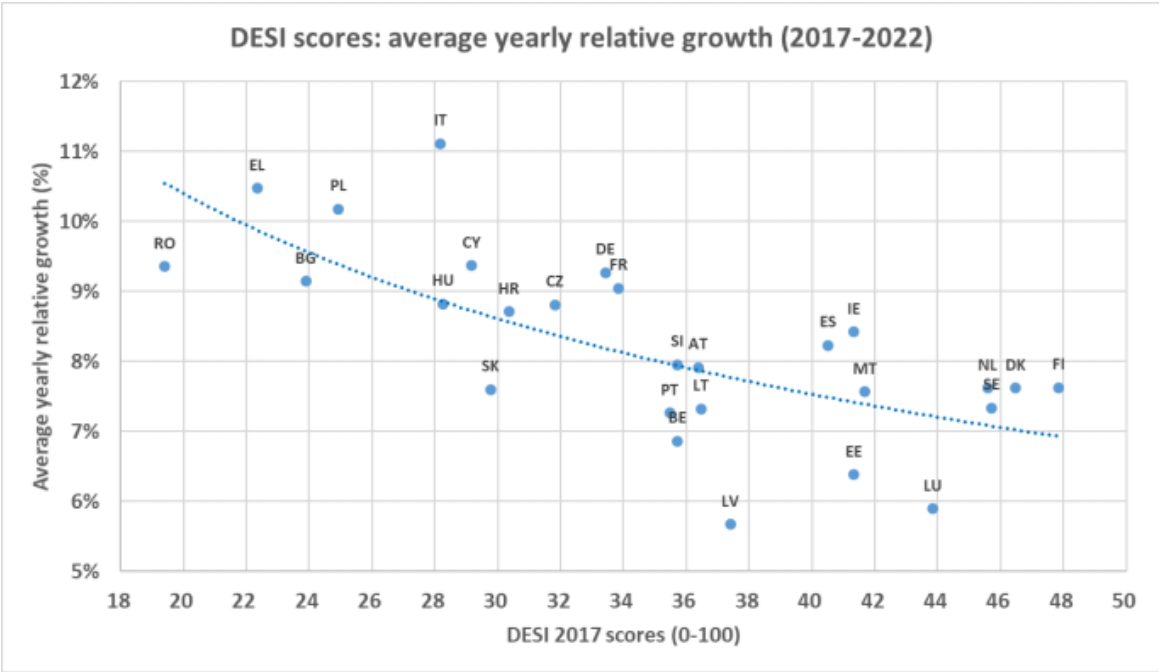

Figure 1.2. Digital economy and society index - relative progress of member states in the period 2017-2022

Source: DESI 2022, European Commission [28]

For each country, the figure shows the relationship between its 2017 DESI score (horizontal axis) and the average annual DESI growth for the period 2017-2022 (vertical axis). As in the classical theory of economic growth, general convergence is observed when countries that start with lower levels of digital development develop at a faster rate (left side of the diagram). The DESI estimates clearly show the general pattern of convergence in the EU between 2017 and 2022.

The blue line in the figure is the estimated convergence model. Countries that are above the blue line have grown more than expected by the convergence curve and are therefore "outperformed". For countries located below the blue line, the opposite is true.

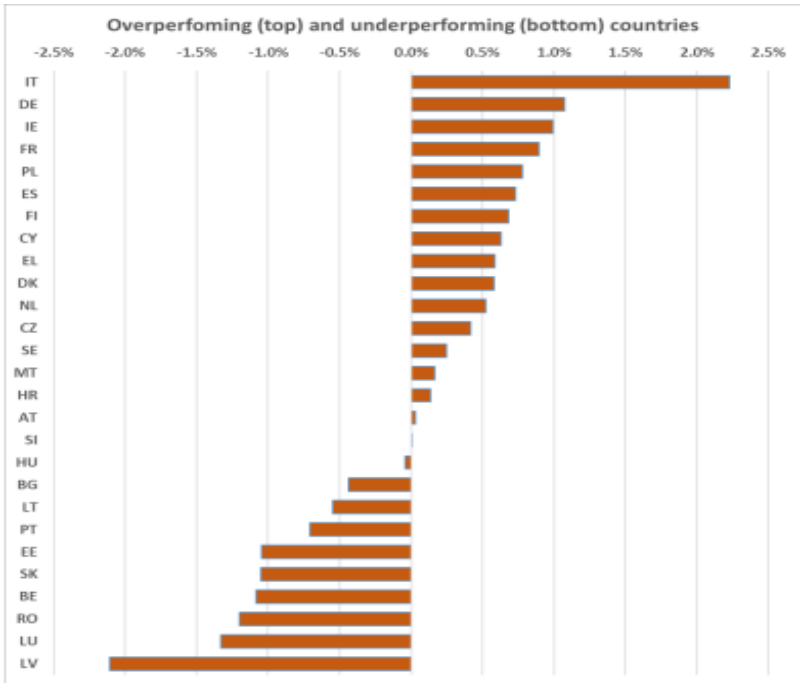

Figure 1.3. Digital Economy and Society Index - Exceeding and Lagging Member States (2017-2022)

Source: DESI 2022, European Commission [28]

The chart below (Figure 1.3) classifies countries with high performance (upper part of the chart) and underperformers (lower part of the chart) according to their distance from the convergence curve (blue line in the figure above). Italy is the best in the first group, as its growth rate significantly exceeded expectations between 2017

and 2022. It is followed by Germany, Ireland, France and Poland among the top five countries. In the bottom group of countries, Latvia improved DESI much more slowly than expected from the convergence curve, deviating from the general pattern of convergence.

Luxembourg, Romania, Belgium, Slovakia and Estonia also deviate significantly from convergence.

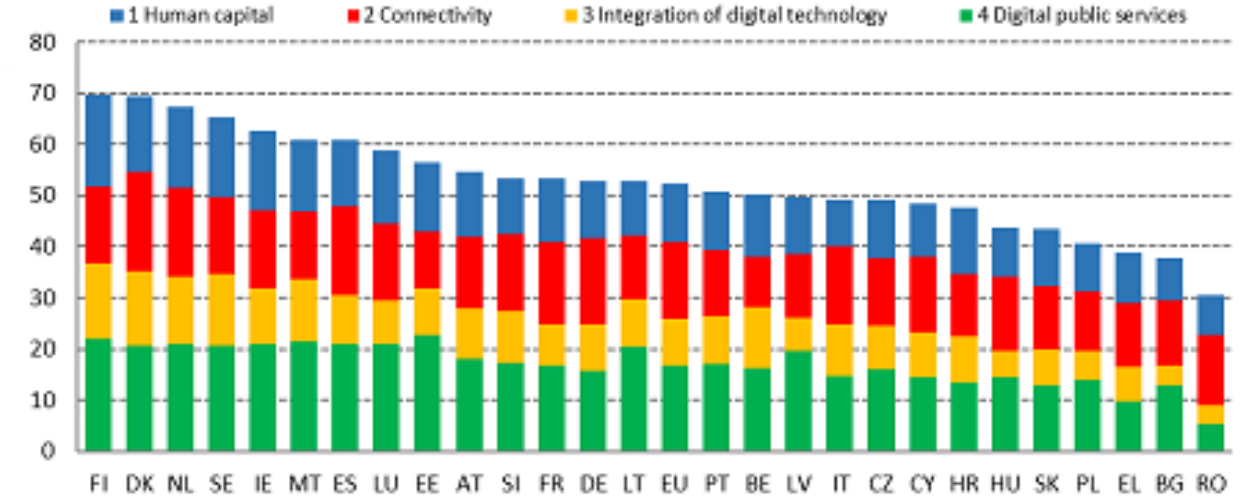

Figure 1.4. Digital economy and society index, 2022

Source: DESI 2022, European Commission [28]

In Fig. 1.4 shows the ranking of DESI member countries for 2022, according to which Finland, Denmark, the Netherlands and Sweden have the most developed digital economies in the EU, followed by Ireland, Malta and Spain. Romania, Bulgaria and Greece have the lowest DESI scores.

Based on the results of the research, the following conclusions can be drawn. The article examines the peculiarities of the Fourth Industrial Revolution and Industry 4.0, which made it possible to clarify the main directions of the development of society: the formation of digital competences and the development of human capital; formation of digital infrastructure; integration of digital technologies in business and everyday life; improvement of digital public services.

The annual reports of the European Commission, which contain the progress of member states in the field of digital technologies in the Digital Economy and Society Index, were studied. The main threats to the economic security of the state were

established according to the researched directions of the development of society, namely: the formation and development of human capital (absence or insufficient level of digital competences); formation of digital infrastructure (high cost of software development); integration of digital technologies into business and everyday life (society's rejection of digital innovations); improvement of digital public services (cyber attacks, leaks of personal data, falsification of data, etc.).

A detailed study of the specified threats and their impact on the economic security of the state can become a direction of further research.

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CERTAIN ASPECTS OF THE POST-WAR RECOVERY OF UKRAINE'S DIGITAL INFRASTRUCTURE

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Citation:
Oliinyk, D. & Nizhnyi, D. (2023). Certain aspects of the post-war recovery of Ukraine's digital infrastructure. *The development of innovations and financial technology in the digital economy:* monograph. OÜ Scientific Center of Innovative Research. 2023. 230 p. PP. 42-61, https://doi.org/*10.36690/DIFTDE-2023-42-61*

Abstract. *The policy in information and communication technologies serves as a basis for the digital transformation of the economy and society. It focuses on measures related to information technologies, communication networks, and services, including technological and security aspects of domestic digital infrastructure development. The policy is in the context of the development of trans-European infrastructure. The digital transition is a central point of the new strategy, which involves an international digital partnership to implement the EU4Digital Initiative in Ukraine. The strategy aims to focus on key areas of the digital economy and society in line with EU norms and practices. It also includes the expansion of network infrastructure, uniting research and educational communities, implementing the broadband strategy, strengthening cybersecurity, and increasing trust in the use of digital services. Digital transformation has the potential to drastically change the economy and society. It utilizes ICT technologies, such as cloud services, communication technologies, big data analytics, artificial intelligence (AI), cybersecurity, cloud, and quantum computing, to drive digital transformation. This approach requires transitioning to more digital and sustainable economic models based on digital infrastructure. However, the full-scale invasion of Russia into Ukraine has slowed down the implementation of these processes. Therefore, it's necessary to identify priority directions for the post-war restoration of the economic landscape. This includes restoring digital infrastructure and identifying the tools needed to achieve this restoration. The purpose of the study is to systematize, coordinate, and prioritize tasks required for developing a strategic plan. The plan aims to restore Ukraine's digital infrastructure amidst war and post-war situations. To achieve this, the study analyzes international experiences and specific measures implemented in EU countries. Based on this analysis, the study outlines practical recommendations for the post-war restoration of damaged and destroyed infrastructure. These recommendations are mutually agreed upon and supported by specific examples to ensure the reliability and stability of the digital infrastructure.*

Keywords: *big data, ecosystem, digital infrastructure cost estimation model, digital infrastructure, digital transformation of the economy.*

On the eve of the International Economic Forum [1], the World Bank published a report called *"Global Economic Prospects"* [2]. The report provides an analysis of the world economy's prospects for 2023-2024. It also proposes economic guidelines and conclusions for the short and medium term. These guidelines and conclusions can be used in the development of economic strategies. According to the report, the slowdown in growth due to the consequences of the war in Ukraine affects 95% of developed economies and almost 70% of markets. In order to form a strategic vision at the World Economic Forum, the *EDISON* Alliance was created, which primarily gives priority to the digital transformation of the economy and society. The World Economic Forum and the Organization for Digital Cooperation have launched a collaboration called the "Digital Foreign Direct Investment Initiative". The initiative aims to identify the biggest challenges of the digital economy. It also aims to help implement policies and measures that will create a "digital" investment climate.

According to the *Global Soft Power Index 2023*, Ukraine ranked 19th among the 20 most influential countries in the world in 2022. This indicates that Ukraine has the ability to influence through attraction and persuasion, including its digital transformation of the economy [3]. In addition, Ukraine was recognized as second in the Open Data Maturity ranking among 35 European countries, rising from sixth to second place among European countries [4]. However, the outbreak of war has drastically changed the situation.

As the war in Ukraine transitioned from a short-lived conflict on February 24, 2022, to a protracted war of attrition, the burden of combat operations increased. Additionally, targeted enemy attacks on the country's digital infrastructure have made it essential to ensure stability. To achieve this stability, the economic system and its participants must be adaptable in their ability to restore and maintain capacity under the influence of uncertain, complex, and difficult-to-predict risks. This includes the risk of physical destruction caused by the war.

However, one year after Russia's invasion of Ukraine, the geopolitical context is increasingly tense and volatile, with an uncertain economic outlook coupled with

rising inflation, supply chain disruptions, energy losses, damage to critical infrastructure, extreme weather events and geopolitical volatility.

According to a joint report by the United Nations, the World Bank and the European Commission, Ukraine's digital infrastructure suffered significant destruction and vulnerabilities due to the military conflict. Russian forces caused massive damage, including to civilian infrastructure. The losses in Ukraine's housing sector reached 50 billion USD after 400 days of full-scale Russian invasion, 4.4 billion USD for educational institutions and 2.5 billion USD for healthcare facilities. According to estimates, Ukraine will need 411 billion USD to rebuild its economy after the full-scale invasion.

Conceptualizing the tasks of restoring Ukraine from the consequences of the war in the form of a comprehensive strategic plan based on the principles of complementarity is an important stage in forming an effective digital strategy for Ukraine's recovery. Such plans may include goals and objectives for the resilience and optimal life cycle of critical infrastructure in a specific sector and require effective information-gathering systems to monitor their compliance and the adoption of a standardized asset management system.

The precondition for a strategic plan in Ukraine should be the creation of an international Register of Damages for documentary fixation of evidence and claims for damages, losses, or injuries for all interested physical and legal persons, as well as the state of Ukraine, caused by international unlawful actions of the Russian Federation in Ukraine or against Ukraine.

From the long-term perspective, the existence of such a strategic plan is a necessary condition for the fundamental transformation of Ukraine into a digital, green, and sustainable economy based on a reliable digital infrastructure, innovative technologies, unlocking data capacity, shaping the regulatory framework, and creating a safe digital environment.

The key to solving the issue of rebuilding and restoring Ukraine's economy in the medium and long term is the fundamental basis on which a dynamic, sustainable

and growing digital economy is built: reliable digital infrastructure, big data, innovation and a secure digital environment.

Digital infrastructure has become a key element of critical infrastructure, the development of all sectors of the economy, economic security, business environment and competitiveness depends on its digital capabilities. Digital infrastructure includes the physical structure; cable and network systems; software and large amounts of data.

As a complex of technologies, products and processes, digital infrastructures provide computing, telecommunication and network capabilities for electronic interaction, data exchange, signals, etc. and operate on a digital basis. Digital infrastructure includes the physical resources required to use data, computerized devices, methods, systems and processes and integrates and connects physical and virtual technologies such as computing, storage, networking, applications and IaaS, PaaS and SaaS platforms to form a digital basis.

The growing number of systems containing physical and digital connections creates space for an ecosystem of connected digital doubles and complex cyber-physical systems that make decisions or support decisions with the help of collected data. However, the information and communication technology (ICT) sector is characterized by rapid technological change and the convergence of technological platforms for telecommunications, information delivery, broadcasting and computing, which are key factors in the development of the digital economy. The development of ICT infrastructure, digital technologies and the convergence of broadcasting, telecommunications and informatics opens up significant opportunities for the introduction of relevant new technologies in Ukraine.

The World Telecommunication Development Conference (WTDC-17), held in Buenos Aires (Argentina), initiated the promotion of modern and secure ICT infrastructure and services, including the strengthening of trust and security in the use of ICT [6]. The Network Infrastructure and ICT Services Program, initiated by WTDC-17, promotes the use of new technologies for the development of information and communication infrastructures and services.

Today, ICT infrastructure has moved beyond simple connectivity and computing to form a digital ecosystem driven by artificial intelligence, data and green technologies, where gigabit broadband infrastructure will provide ubiquitous real-time computing power and is optimized for growth, cost, and robustness. Digital technologies enable basic business operations, which is becoming a strategic imperative and the new norm and expected standard.

The digital infrastructure consists of all electronic and non-electronic assets used to provide broadband services to users, and in the context of this publication includes durable physical assets that transport and store data. Data infrastructure is vital to the delivery of mission-critical services and is essential to the functioning of major sectors of the economy, including financial systems, utilities, industrial supply chains, media, and telecommunications. Data generation and consumption, an ever-increasing number of connected devices, the rise of cloud computing, and the deployment of 4G and IoT devices are accelerating the growth of both mobile and fixed devices. Internet traffic is expected to grow to 175 zettabytes worldwide by 2025.

Digital technologies of the new technological framework are the driver of significant structural changes not only in the systems and ways of meeting the needs of consumers but also in economic development models to encourage the development of a generally accepted class of sustainable infrastructure assets. However, according to the report of the Global Future Council on Infrastructure of the World Economic Forum (hereinafter – the Council), currently, infrastructure remains one of the sectors of the economy with the least number of digital transformations [7]. Taking into account the need to innovate and build a technologically structured digital infrastructure, taking into account economic, social, environmental and technological components, the Council developed six characteristics of a sustainable digital infrastructure (GFC-6) [8], namely: access and sharing of benefits, logical and climate sustainability, social acceptability, economic and institutional efficiency, perspective throughout the life cycle and critical mass potential due to reproducibility.

According to the recent report “Digital Economy Documentation – Asia Pacific”, it is noted that the digital economy of the first level of ICT infrastructure (*Digital First Economy, DFE*) contributes to inclusive, innovative, sustainable and ecological economic growth [8]. *DFE* indicators indicate a significant multiplier effect of GDP growth. Each US dollar of ICT investment generates $13 of GDP, and a one-point increase in DFE correlates with a 3% increase in GDP.

Investing in universal digital infrastructure is essential to the adoption of the Internet and is a key objective of 9 Industry, Innovation, and Infrastructure. Creation of sustainable infrastructure, promotion of inclusive and sustainable industrialization and innovation of the Sustainable Development Goals of the UN [9]. Achieving universal broadband requires investment in infrastructure [10]. The availability of Internet connectivity can provide new economic opportunities for unconnected communities and help facilitate larger structural shifts in the digital transformation of the economy and society [11].

In order to attract funds for digital infrastructure, the IMF has developed a new model for estimating the costs of digital infrastructure (*Digital Infrastructure Costing Estimator, DICE*) taking into account the demographic forecast trends of each country, population, density, and future economic characteristics. The DICE model estimates the cost of investing in digital infrastructure to deliver affordable universal broadband by 2030 using harmonized global datasets to assess broadband infrastructure needs [12].

Consistent tracking of digital progress and evaluation of the results of the EU, as a whole, and individual EU member states, as well as their comparison with the indicators of leading countries that are not part of the EU, is carried out annually by the European Commission with the help of Digital Economy and Society Index reports and SocietyIndex, DESI) and international DESI index (I-DESI) [13]. DESI illustrates the evolution of digital transformation in Europe and consists of five components covering societal and economic aspects, namely measurement:

- deployment of broadband communication infrastructure;
- skills necessary for use in the digital society;

- online activities of citizens and use of Internet services;
- integration of digital technologies;
- digitalization of public services.

The DESI/I-DESI component “Integration of digital technologies” measures the availability and adoption of technologies by enterprises and the development of e-commerce. This is facilitated in accordance with the initiative of the European Commission and the formation of the European digital passport of an ecological product (Sustainable Products Initiative). This initiative provides the opportunity to mark, track, localize and exchange data related to the creation of value chains down to the level of individual components and materials. In order to create conditions for the inclusion of Ukraine in the EU Digital Economy and Society Index and the implementation of EU approaches, it is planned to introduce data collection and measurement of indicators of the digital economy and comparison with indicators of digital economies of European countries by the government of Ukraine already in 2023.

The *DICE* model, taking into account the *DESI* indicators, allows for the assessment of investments in digital infrastructure and the achievement of universal broadband connection. The model involves investment in infrastructure to support mostly terrestrial 4G deployments, while also involving investment in satellite connectivity in areas that require remote coverage in very hard-to-reach locations. The motivation for using cellular wireless is that it is one of the cheapest ways to affordably provide wide-range broadband services, as broadband consists of the first mile (where and how the connection enters the country), the middle mile (how data packets are transported over long distances between different regions) and the last mile (how data packets are distributed locally among end users).

A sensitivity analysis of key model parameters demonstrates that future broadband policy evaluation should clearly indicate the amount of data that each user can consume. To ensure universal broadband, according to the basic assumptions of the IMF, the need for necessary investments is estimated at 418 billion US dollars or approximately 0.45 percent of the world GDP. This estimate is based on the

assumption of providing universal 4G cellular broadband to users with approximately 40-50 GB of data per month with 95 percent reliability [14]. According to the IMF's estimates, the total needs in emerging market economies amount to $305 billion (73 percent). Demand is assessed to obtain the required amount of traffic to be served, network sizing and cost estimation metrics. Each of the three main modules will be presented as demand, network sizes and costs.

Before quantifying the cost of building the necessary infrastructure, the model begins by estimating future demand data. For the calculation of digital infrastructure assets, the key elements of investment programs and economic development models are:

- determination of infrastructure needs, including the inventory of existing infrastructure assets;

- definition of goals and expected results in combination with a predetermined set of sustainability factors relevant to the system;

- a creation of a template for analyzing the costs and benefits of including conditions and characteristics of sustainability in the necessary infrastructure;

- inclusion of sustainability goals, especially in the early stages of the strategy and design of infrastructure assets.

In addition, when creating or using a model of economic development, the main areas of application should be (Fig. 1.5):

- economic — cost/benefit analysis, asset life cycle analysis, costs, optimization, bankruptcy, etc.;

- environmental — mitigating the consequences of natural disasters and climate change, resilience to climate change, ensuring efficient use of energy during construction and operation, optimizing the use of natural resources, optimizing land use, minimizing waste;

- social – participation of the community/beneficiaries, availability of infrastructure for the population, health, and safety;

- technical – site research, design and alternative options, an interdisciplinary approach of complex design, starting with technical and economic justification,

meeting functional and aesthetic requirements, integrating design with the stages of construction and operation,

- regulatory requirements related to sustainable infrastructure;

- design/project management – involvement of contractors, suppliers at the design stage, design, control taking into account the interests of the community;

- the choice of materials — low energy/water consumption, technologically innovative, strong and durable materials and the use of locally produced materials.

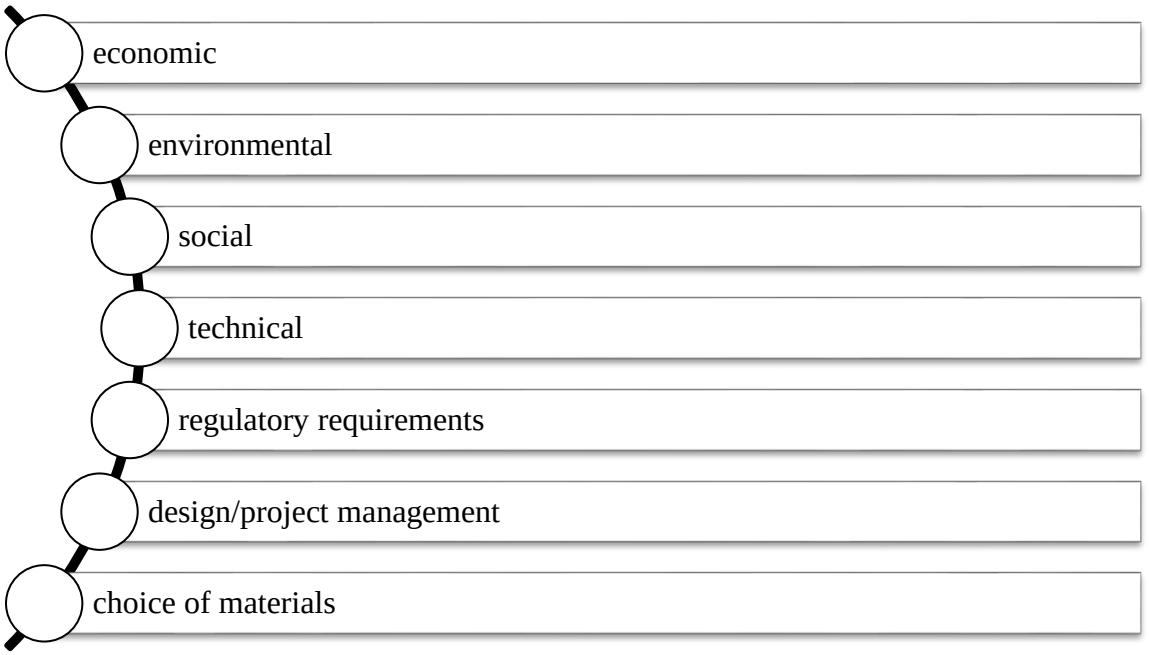

Figure 1.5. The main areas of application of the model of economic development

Sourse: developed by authors

More and more countries are realizing the importance of taking advantage of the digital economy for innovation, growth and social prosperity. This awareness comes as the cost of data collection, storage, and processing increasingly migrates to the Internet. Technology, smart applications and other innovations in the digital economy can improve services and help solve a wide range of issues, including health, agriculture, governance, taxation, transport, education and more. ICTs contribute not only to innovations in products, but also to innovations in processes and organizational mechanisms.

As the consumption of digital data grows, so does the importance of access to a high-performance digital infrastructure to connect, transport and store this data based

on international standards. Currently, about 80% of big data standards are developed by *ISO/IEC* technical committee *JTC 1/SC 42 – Artificial Intelligence.* In addition, big data terminology is defined in ISO/IEC 20546, while the big data reference architecture is covered by *ISO/IEC 20547-3*, and *ISO/IEC TR 20547-2* and *ISO/IEC TR 20547-5* describe the roadmap of existing and future standards in this field 15. The development of big data analytics regarding the life cycle of data science, which is developed by ISO/AWI TR 23347 [16], is timely and relevant.

A tool for measuring countries' performance against key factors of mobile Internet adoption is the *Global System for Mobile Communications* (*GSMA*) Mobile Connectivity Index, which outlines global connectivity trends in mobile Internet connectivity and accelerating digital engagement (infrastructure, affordability, consumer readiness, services). According to the report "The State of Mobile Internet Connection in 2022" in Ukraine, the *GSMA* index, in comparison with previous years, has increased by 1.6% and is 72.6% [17]. The key indicators of the index are infrastructure coverage – 65.6%, availability – 64.7%, consumer readiness – 89.5%, and services – 73.2%.

The placement of digital infrastructure at the centre of economic policy programs can unlock economic opportunities, create jobs, promote growth, and improve quality of life. In addition, the provision and implementation of digital services that use broadband communication can allow workers affected by technological economic transformation to retrain, while also providing access to essential services such as financial services, healthcare, education, and more. Furthermore, a higher level of digitization can help expand the tax base and increase revenue collection, as well as transform the management of public finances by modernizing relevant systems, improving the provision of public services, enabling digital payments, and promoting transparency.

An example of the construction of the government's digital policy for the near future, taking into account the above-mentioned postulates, can be the *Digital Strategy of Great Britain*, which focuses on 6 key areas [18]:

- *digital basis:* update of the Plan for digital regulation of the digital economy (digital infrastructure, data, regulation, digital markets, security);

- *ideas and intellectual property:* consolidation to support the innovation ecosystem, with a special emphasis on digital technologies;

- *digital skills and talent:* reforming and improving skills and talents for the digital economy;

- *financing digital development:* improving the technological ecosystem with access to financing through the British Business Bank and British Patient Capital, introducing the technological revolution into the economy through Fintech;

- *increasing the level of use of digital technologies to support the achievement of key strategic priorities:* increasing productivity through the introduction of technology, improving public services, improving the level and net-zero;

- *use of strategic advantages* in digital and technological spheres and establishment of global standards of digital products and services.

National digital security strategies play a key role in strengthening trust in digital technologies by creating the conditions for all stakeholders to manage digital security risks in the economy and public activities. Governments of many countries are increasingly aware of the need to develop the digital economy strategically in order to expand their advantages and respond to the key challenges of today. Modern national digital strategies cover a variety of business creation and productivity growth challenges for public administration, employment and education, health and livelihoods, environmental protection, and economic development.

Most OECD countries have adopted or are close to adopting national strategies related to the digital economy. Germany's digital agenda emphasizes “increasing the use of the potential of innovation to achieve further growth and jobs” as a key goal (in addition to strengthening high-speed networks and trust). Germany's smart grid initiative aims to strengthen basic infrastructure, develop cooperation between infrastructure sectors, improve basic conditions and increase early-stage stakeholder participation with the ambition to expand and deepen the integration of applications and smart grids. Another program under the Digital Agenda aims to help small and

medium-sized enterprises understand the importance of using software for business processes and support these companies to digitize.

Mexico's National Digital Strategy plans to make Mexico a “leading digitization country in Latin America” with a focus on promoting innovation and entrepreneurship in the digital economy, among other priorities. Mexico's *Creative Digital City* initiative aims to create an urban “ecosystem” that concentrates on creative industries (film and television studios, mobile applications, interactive media, etc.) to harness the creative potential and talent of people in Guadalajara, along with the use of technology to drive innovation to maximize economic, environmental and social benefits.

In *Brazil*, the Strategic Information Technology Software and Services Program (TI Major) aims to improve Brazil's performance in the ICT sector and focuses on innovation, entrepreneurship, and competitiveness.

Colombia's Vive Digital plan includes the Digital Talent Initiative, Apps.co for digital entrepreneurship and the Digital Content Initiative.

In recent years, policymakers have increasingly focused on promoting the open, distributed, and interconnected nature of the Internet, while protecting the privacy and managing digital security risks to build trust in the digital economy.

Japan's National Parliament has amended the Personal Information Protection Act to introduce new definitions of confidential and anonymous personal information, as well as new rules for cross-border transfers. A key element of the updated Japanese privacy legislation is the creation in 2016 of the independent agency of the Commission for the Protection of Personal Information and the exercise of control over the protection of the rights and interests of citizens in this area.

To bridge the digital divide, *China* has launched a national broadband strategy that aims to connect 98% of Chinese villages to 2Mbps fixed broadband by 2020. China Telecom is also partnering with Alibaba Group to promote low-cost smartphones in rural areas.

To successfully use the potential of innovation and growth of the digital economy, high-quality access to communication infrastructure at a competitive price is necessary. This, in turn, requires sufficient trust in the reliability and security of digital networks, respect for privacy and consumer rights.

High-speed networks and services are essential for future economic growth, job creation and competitiveness. Public policy is aimed at promoting strong competition in the provision of high-speed broadband Internet access services and encouraging investment in these networks to achieve the greatest geographic coverage. There is now a need to close the digital divide, which acts as an obstacle to the deployment of the Internet of Things in areas such as healthcare, transport, and energy to improve competitiveness, the environment, and well-being.

Strong privacy protections are critical to ensuring that the social and economic potential of the digital economy is harnessed. Privacy can be protected based on globally recognized principles, such as the OECD Privacy Guidelines, under which governments work to achieve global compatibility by expanding mutual recognition of privacy frameworks that achieve the same goals.

Особливо важливе значення в цьому контексті приділяється розвитку більш стійкої до потенційних загроз критичної інфраструктури, інноваційних технологій і ланцюгів постачання.

Critical infrastructure is considered as an asset, object, equipment, network, or system or a part of an asset, object, equipment, network, or system that is necessary for the provision of basic services and significantly affects the social and economic well-being of the country's population [19]. Classic examples of assets are data centers, fibre optics, last-mile broadband, and cell towers. Most of the revenues from digital infrastructure assets in international practice are now indexed by the passively managed byte (BYTE) investment fund (Exchange Traded Fund, ETF), which trades on the stock exchange. BYTE index includes such main verticals of digital infrastructure as data centers; mobile infrastructure (towers, cellular communication, etc.); infrastructure of broadband access to a fixed line (optical fiber, cable).

From a security perspective, critical infrastructure (cyber and physical) is the fundamental basis for the functioning of every aspect of society. Adverse impacts on critical infrastructure include events or incidents that threaten public safety and trust, threaten economic and national security, harm international competitiveness, and impede industrial development and their ability to deliver essential services.

The growing interdependence between infrastructure and sectors is the result of an increasingly cross-border and interdependent service delivery network using key infrastructure in energy, transport, banking, drinking water, wastewater, food manufacturing, processing and distribution, healthcare, space, infrastructure financial market and digital infrastructure, as well as in certain aspects of the public administration sector.

The EU's Critical Facilities Resilience Directive, adopted in January 2023, aims to strengthen resilience against a range of threats, including terrorist attacks, natural hazards, internal threats or sabotage, and emergencies under new rules that require the adoption of a national strategy and carrying out regular risk assessments to identify entities that are considered critical or vital for society and the economy [20].

The space sector is subject to this Directive in relation to the provision of certain services that depend on ground infrastructure owned, managed and operated by countries. The new European Space Strategy for Security and Defense is focused on protecting space assets, deterring hostile activities in space, and strengthening strategic position and autonomy [21].

The recently established NATO-EU Task Force on Critical Infrastructure Resilience covers critical sectors of the economy, including new and revolutionary technologies for the impact of climate change on security [22].

The stability of critical infrastructure and critical objects is vital in maintaining economic activity and social functions in the domestic market in the conditions of increasing interdependence of the economy of Ukraine with partner countries due to disruption or destruction of infrastructure due to dynamic hybrid and terrorist threats of the russian federation, as well as growing interdependence between infrastructure and sectors, which will have a significant cross-border impact.

Digital infrastructure in Ukraine in the energy, transport, industrial, and water sectors plays a decisive role in accordance with international commitments regarding the Paris Agreement on climate change and the Sustainable Development Goals (SDGs). Ukraine's rating of infrastructure indicators in the World Bank's *Logistics Performance Index* (LPI) shows that over the last decade, the quality of infrastructure has deteriorated both in absolute terms and in comparison with other countries. In 2007, Ukraine ranked 74th in the world with an average infrastructure index (2.35), and in 2018 – 119th with a score of (2.22) [23]. However, in the World Economic Forum's Competitiveness Index for 2019, the quality of Ukraine's infrastructure is assessed positively. Its indicator (70.3) is significantly higher than the average indicator for countries with a lower average income level (60) [24].

The creation of a platform for operational monitoring of the state of the energy industry and accounting of assistance *"Energy Aid"* is a top priority in establishing supply chains and coordination mechanisms between the customer, companies in the energy sector affected by russian armed aggression against Ukraine, and international donors and suppliers for emergency equipment repair. This includes creating a "single window" tool to address issues related to emergency repairs and find the necessary equipment for Ukraine's digital energy infrastructure, as well as interconnecting parties [25].

According to the OECD database, before the beginning of the Russian invasion, more than 77 infrastructure projects with a total cost of 37.0 billion US dollars were implemented in Ukraine. The largest share in terms of value was allocated to projects in the transport (55%, USD 20.3 billion) and energy (40%, USD 15.6 billion) sectors. Inadequate quality of infrastructure systems of Ukraine and the need for post-war reconstruction is defined as a key structural bottleneck, which prevents the formation of innovative digital infrastructure and bringing it into line with international norms and rules. Standardization in the field of ICT infrastructure covers areas such as planning and installation of networks (ISO/ IEC 14763-2 and ISO/IECTR 14763-2-1), enterprise telecommunications networks (ISO/IEC 17343), urban networks (ISO/IEC/IEEE 8802-A), private integrated telecommunications networks (ISO/

IECTR 14475) and wireless networks, networks of the next generation (ISO/IEC TR 26905). In addition, ISO implements standards for so-called future networks, which are intended to provide futuristic capabilities and services beyond the limitations of current networks, including the Internet.

A prolonged and widespread power outage, caused by the full-scale aggression of russia against Ukraine, has led to a massive impact on water supply and sanitation, which in turn affects public health. It has resulted in reduced service delivery, disconnection of banking, financial, and retail sectors, as well as instability in food supply and disruptions in transportation and telecommunications networks.

The roadmap for the development of digital infrastructure and asset recovery for Ukraine in the post-war period should prioritize energy resilience and security, overcoming market instability and geopolitical tensions to enable the implementation of next-generation mobile technologies, including 4G and 5G, which offer new technical possibilities, including virtual reality (VR) and augmented reality (AR) in education, healthcare, transportation, and more. Ukraine's participation in the EU program “Digital Europe”, the development of the resource base, the improvement of the unified interoperable system of public e-registries, the introduction of the electronic presidency, digitization of subsoil use, and waste management are key tasks in the near future [26].

According to the International Energy Agency, in order to achieve the goals of the Paris Agreement, it is necessary to increase the supply of critical minerals by 2040 — 7 times rare earth elements and 42 times lithium [27]. Securing the supply of these minerals is a priority for all OECD governments. The concentration of mineral reserves, critical for the green transition, is of significant importance for Ukraine as well. In 2021, Ukraine was among the top 10 countries in the production of titanium, iron ore, kaolin, manganese, zirconium, and graphite. Among the 120 types of minerals consumed in the world, 117 were discovered in the bowels of Ukraine, concentrated deposits of 22 of 30 minerals that are included in the list of critical for the EU. Among them are lithium, beryllium, rare earth elements, nickel and cobalt. Several minerals will underpin the transition to low-carbon energy. These include

cobalt, nickel, and lithium contained in electric vehicle batteries; rare earth elements, which are critical for the production of wind turbines; and copper, necessary for all clean technologies (eg photovoltaic systems, bioenergy, wind turbines or electric cars), which will be important for Ukraine's participation in the EU's Digital Europe program and the construction of modern digital infrastructure.

Creating conditions for the influx of technological companies into Ukraine and the cooperation of foreign customers with domestic enterprises through the regulatory regulation of the functioning of digital innovation hubs (*Digital Innovation Hub*) and business innovation centers is a priority task of their integration into the European network, proactively attracting investments from international companies to form a modern digital infrastructure with an extensive network

The implementation of specific measures for the restoration and development of digital infrastructure in the conditions of war in Ukraine requires a transition to practical productive actions in all areas of digital transformation, the development of a pool of strategic documents agreed among themselves and supported by thorough analysis, in particular regarding:

- implementation of a set of measures for the restoration and development of the system of research infrastructures and the development of a mechanism for consolidating the efforts of executive authorities, science and international organizations that provide international technical assistance for the restoration and development of the system of e-infrastructures that were critically affected by hostilities during martial law. To do this, develop a state program aimed at ensuring inventory and systematization of research infrastructures and assessment of their compatibility with European research infrastructures;

- establishment of integration and interaction of digital infrastructures using IT technologies for conducting joint research and providing remote access and the possibility of uniting geographically distant scientific centers that suffered as a result of the Russian military invasion of Ukraine in the format of joint research infrastructures using joint scientific equipment and activation mobilization of resources for their development;

- creation of a single online portal for posting information about unique e-research infrastructures at the national level that go through a full life cycle (design, construction, use and provision of services, development and renewal or liquidation) for the provision of services for the maintenance and development of the scientific and innovative sphere in the conditions of the war and the post-war period in order to increase their competitiveness;

- introduction of new-generation Internet platforms to stimulate the process of digital transformation and facilitate collaboration and knowledge exchange (intelligent global search engine, customizable design, integrated content management, multilingual interface, etc.). Implementation of appropriate digital accounting tools for project management, recruitment, payroll, customer relations (CRM), content management system (CMS) software;

- introduction of legal regulation and functioning of digital platforms as business tools of the digital economy of public (financial, tax) and private (civil, economic, labor) law and regulation of relations in the field of personal data processing, taking into account the collection and processing of information using big data technologies through EU4Digital correspondent networks, which serve as platforms for the exchange of best practices and experiences from the EU and reflect the main directions of digital development on the way to the EU Digital Single Market (ICT innovation, telecommunications, e-health system, e-commerce, e-skills , security, etc.);

- harmonization of the use of digital data of remote, terrestrial observations shared with the world community, development of a methodology for evaluating modeling results in the post-war period for solving applied problems of environmental security, energy, climate change, biodiversity, food security, forest, water, and agricultural resources within the framework of creation Global Earth Observation System (GEOSS);

- increasing the availability of space data and signals to address various types of natural, technological and societal threats and vulnerabilities caused by war and their early warning. In the current state of war, this process consists of determining the

coverage level of complementary, overlapping satellite systems and the availability of data for dual-purpose systems that play an important role in aviation, as well as in precision agriculture, maritime and land transportation, and mapping [1]. Satellite signals and images of the aggressive war of the russian federation against Ukraine now have the ability to support unprecedented coverage of events in almost real-time;

- improvement of effective and responsible access and data exchange in accordance with agreed international principles [1] to increase the credibility of the data ecosystem. This approach involves promoting inclusive representation of stakeholders in the data ecosystem; increasing the transparency of access to data and the mechanisms of their joint use; data sharing competition, including public-private partnerships, as well as the empowerment of individuals, social groups and organizations.

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FORMATION AND DEVELOPMENT OF DIGITAL COMPETENCIES IN THE CONDITIONS OF DIGITALIZATION OF SOCIETY

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Citation:
Zhyvko, Z., Petrukha, N. (2023). Formation and development of digital competencies in the conditions of digitalization of society. *The development of innovations and financial technology in the digital economy:* monograph. OÜ Scientific Center of Innovative Research. 2023. 230 p. PP. 62-85, https://doi.org/*10.36690/DIFTDE-2023-62-85*

Abstract. *The active development of the digital economy in all countries of the world presupposes the availability of specific digital competencies among employees. The purpose of the study is the formation and development of digital competences, which the digital society requires from the population. The research methodology involves the use of various methods and techniques, including: the historical method - for researching the development of digital competencies; graphic method - for a schematic representation of research results; comparative method - for comparing competencies in different countries; methods of analysis and synthesis - to create the Levels of digital competence proficiency scale and others. Researched the classification that exists in the EU contains three main categories of DSC for students / citizens: digital competence; special digital skills; digital skills for ICT professionals. The main competence areas of DigComp have been systematized. A Model of formation and actualization of needs for the development of digital competencies has been developed, which includes the following components: needs, conditions, motives and incentives, voluntary and coercive measures aimed at the formation and actualization of these needs. The main strategic directions for the development of digital competences in the conditions of digitalization of the economy have been developed. A general scheme for assessing the impact of digitalization of the economy on the demand and supply of jobs is proposed. The methodological approaches can help find answers to special and specific questions, in particular about the impact of digitalization of the economy on competencies and their combinations, the emergence of new professions, understand the expectations of the labor market by studying its demand for professional skills rather than skills listed in standard job descriptions, as well as develop substantiated proposals for improving labor market and field policies in Education.*

Keywords: *digital economy; digital society; digital competences; digital skills; workplace; employee.*

The digitalization of the economy and society requires not only technical and technological changes, but also the transformation of employee competencies in accordance with modern requirements for the professional qualification level of employees of the digital economy. Approval of the Concept for the Development of the Digital Economy and Society of Ukraine for 2018-2020 [1] and the approval of the action plan for its implementation contributed to the introduction of measures to overcome the "digital divide" and "acquisition of digital competencies by citizens", but the issue of ensuring the development of digital competencies of the population remains extremely relevant. In order to solve the tasks of increasing the level of digital literacy of the population and developing digital skills and digital competencies, including by defining a system and describing the components of digital competence and ensuring legal regulation of these issues, the Concept for the Development of Digital Competencies (hereinafter referred to as the Concept) was adopted and an action plan for its implementation was approved [2].

The general provisions of the Concept define digital competence based on the interpretation of competence in the Law of Ukraine "On Education" as a dynamic combination of knowledge, skills, ways of thinking, attitudes, values, other personal qualities that determines the ability of a person to successfully socialize, conduct professional and / or further educational activities (information and communication competence is included in the list of key competencies that are formed in the process of complete general secondary education), namely: digital competence is a dynamic combination of knowledge, skills, ways of thinking, attitudes, other personal qualities in the field of information and communication and digital technologies, which determines the ability of a person to successfully socialize, conduct professional and / or further educational activities using such technologies.

The Concept also presents the concept of information and communication competence, which means confident, critical and responsible use of digital technologies for one's own development and communication; the ability to safely use information and communication tools in education and other life situations, adhering to the principles of academic integrity [3]. This concept is close to the definition of

digital competence in the DigComp 2.0 document [4]. In the text of the Concept, the terms "digital skills" and "digital competencies" are used in all subsequent provisions without disclosing the content and specifying the difference. How different equivalent concepts of "digital skills", "digital competencies", "digital literacy" are used in the Concept to reveal certain features of the process of acquiring digital knowledge. In the description of the Digital Competence Framework for Ukrainian citizens [5], developed in accordance with the Concept, two more definitions of digital competence (pp. 5-6) and in the glossary (pp. 52-53) are proposed, which differ from the definitions provided in the Concept. Consequently, there is a "conceptual confusion".

The development of the categorical apparatus continues, researchers use similar terms, such as information and communication competence, information and digital competence, digital competence, ICT competence, etc. In the study of the European Foundation for Education (ETF) [6], the definitions of digital skills and competence (DSC) and digital and online learning (DOL) are applied.

The classification that exists in the EU contains three main categories of DSC for students/citizens:

- ***digital competence***, also called digital literacy, encompasses a set of basic digital skills that includes information literacy and data literacy, online communication and collaboration, digital content creation, security and problem-solving. Digital competence is the ability to apply these digital skills (knowledge and attitudes) confidently, critically and responsibly in a defined context (e.g. education). Since 2006 digital competence is one of the eight key competencies in the EU for lifelong learning;
- ***specialist digital skills*** – *a* set of specific digital skills for workplacers, including the use and maintenance of digital tools such as 3D printers, CAD software and robots;
- ***digital skills for ICT professionals*** – a set of advanced, highly specialized, digital skills for ICT professionals, such as programmers and cybersecurity experts, who are expected not only to use but also improve existing information and

communication technologies and create innovative new solutions [6].

According to the DigComp and DigComp 2.0: The Digital Competence Framework for Citizens [4], digital competence is the confident and critical use of ICT tools in the areas of employment, employment, education, leisure, inclusion and participation in society, which is vital for participation in modern society and economy (European Parliament and the Council, 2006). The digital competence system for citizens, also known by the acronym DigComp, was first published in 2013 by the European Commission. This document (Digital Competence System for Citizens) was aimed at increasing the digital competence of citizens, assisting in the development of appropriate policies that support the formation of digital competence, as well as planning initiatives in the field of education to improve the digital competence of specific target groups.

According to the Framework of updated key competencies for lifelong learning [7]:

- ***Competencies are a combination of knowledge, skills and attitudes*** where: knowledge consists of facts and figures, concepts, ideas and theories that are already established and support understanding of a particular field or subject; skills are defined as the ability and ability to perform processes and use existing knowledge to achieve results; attitudes describe dispositions of perception and disposition regarding ideas, person or situation, encourage appropriate reactions or actions;
- ***Literacy is the ability*** to discern, understand, express, create and interpret concepts, feelings, facts and opinions orally and in writing, using visual, sound and digital materials in different disciplines and contexts;
- ***Digital competence*** *is the* confident, critical and responsible use and interaction with digital technologies for study, professional activity (work), participation in society. Includes digital and information literacy, communication and collaboration, digital content creation (including programming), cybersecurity, and problem-solving.

The core knowledge, abilities, skills and attitudes related to digital competence are as follows:

- knowledge of how digital technologies can support communication, creativity and innovation. Awareness of their capabilities, limitations, impacts and risks;
- understanding of the general principles, mechanisms and logic of digital technologies;
- knowledge of basic functions and the use of various devices, software and digital networks;
- knowledge of legal and ethical principles related to the use of digital technologies;
- digital competence involves the ability to use digital technologies to support creativity, active citizenship and social inclusion, collaborate with others to achieve personal, social or commercial goals;
- skills include the ability to use, access, filter, evaluate, create, program and share digital content [7].

Thus, as evidenced by the above approaches to defining the concepts of "digital skills", "digital competence", "digital literacy", in most cases there is an equation of digital competence with digital literacy, although digital competence implies the ability to apply digital skills, and digital literacy is the ability to distinguish, understand, create and interpret digital materials based on knowledge and attitudes. In turn, digital skills imply the availability of digital literacy for the use, maintenance, creation of digital tools, information and communication technologies, as well as the use, creation, programming and exchange of digital content. To understand the differences in the level of ownership and scope, regulatory and research documents propose definitions for different professional groups and their specification for ICT workers. In the adopted Concept, key concepts need to be specified in order to avoid tautology and understanding of the main ideas and provisions of this conceptual document.

Along with the lack of a unified approach to defining the concept of "digital competence", there are different approaches to their classification and allocation of

levels. As an element of the ET 2020 strategy, the European Commission's Joint Research Centre (JRC) has developed two reference frameworks to support the coherent conceptualisation and development of the DSC among EU Member States (Table 1.3).

Table 1.3. European DSC Framework for Citizens, Teachers and Educators

Structure and tools	Target group	Content
Digital competence system for citizens (DigComp 2.1). Self-assessment tool and techniques developed with the JRC	For all citizens	Conceptualization of digital competence for citizens regarding lifelong learning (21 competencies grouped into 5 areas). Progression model based on 8 levels of knowledge
Digital Competence Framework for Educators (DigCompEdu) Self-assessment tool and guidelines developed with the JRC	Teachers and teachers	Conceptualization of digital competence for teachers (22 competencies grouped into 6 areas). Progression model based on 6 levels of knowledge

Source: [6]

For both frameworks, each competency has a descriptor with examples of activities and digital technologies; It also includes a range of levels of knowledge (6 for teachers and 8 for citizens) that can be used to develop individual progression models. In May 2017, DigComp 2.1 (current version) expanded the initial level of three knowledge to eight more detailed. DigComp combines basic DSC into five areas of competence (Table 1.4), including 21 competencies assessed at eight levels of knowledge, described in terms of learning outcomes, with use cases [6].

Table 1.4. DigComp areas of expertise

Field	Description
Information literacy and data literacy	To formulate information needs, search for and access to data, information and content in digital environments and move between them. Create and update personal search strategies
Communication and collaboration	To interact through a variety of digital technologies and understand the appropriate digital communication tools for a given context
Digital content creation	To create and edit digital content in various formats to express yourself through digital means
Security	To protect devices and digital content, understand the risks and threats that exist in the digital environment. Be aware of security measures and due attention to reliability and confidentiality
Troubleshooting	To identify technical problems in the operation of devices and the use of the digital environment and solve them (from troubleshooting to solving more complex problems)

Source: [6]

DigComp 1.0 Framework had three skill levels: basic, intermediate and advanced (advanced), in DigComp 2.1 their number was increased to 8 (Table 1.5). A wider and more detailed range of knowledge levels supports the development of learning materials.

At the initiative of the Ministry of Digital Transformation of Ukraine, experts adapted the European conceptual and reference model of the Digital Competence Framework for EU Citizens (DigComp 2.1) to the national, cultural, educational and economic peculiarities of Ukraine.

Table 1.5. The main keywords characterizing the skill level

Level in DigComp		Complexity of tasks	Autonomy	Cognitive domain
1.0	2.1			
Base	1	Simple tasks	With the head	Remember
	2	Simple tasks	Alone or with a supervisor if necessary	Remember
Medium	3	Well-defined and routine tasks and simple problems	Yourself	Understanding
	4	Tasks and clearly defined non-template problems	Independently and according to their needs	Understanding
Advanced	5	Tasks and problems of varying degrees of complexity	Manages the work of other users	Application
	6	The most difficult corresponding tasks	Able to adapt to others in a complex context	Evaluation
Highly specialized	7	Complex problems with limited solutions	Integrates to promote professional practice and guide others	Creation
	8	Complex problems taking into account the influence of many interacting factors	Offers new ideas and processes on the ground	Creation

Source: [6]

In the Digital Competence Framework for Ukrainian citizens, the level of competence proficiency is conditionally divided into a set of six areas of competence: basics of computer literacy; information literacy, ability to work with data; creation of digital content; communication and interaction in the digital society; security in the digital environment; problem solving in the digital environment, lifelong learning [8].

In contrast to the areas of competence, DigComp distinguishes zero level – the basics of computer literacy and 6 levels of digital competence (Table 1.6).

Table 1.6. Levels of digital competence proficiency

Proficiency levels		The complexity of the tasks	Autonomy of work	Cognitive domain
Base	A1	Simple tasks	With the head	Remember
	A2	Simple tasks	Alone or with a supervisor if necessary	Remember
Medium	B1	Clearly expressed and template tasks, simple problems	Yourself	Understanding
	B2	Tasks and clearly defined non-template problems	Independently and according to their own needs	Understanding
High	C1	Tasks and problems of varying degrees of complexity	I manage the work of other users	Application and evaluation
	C2	Complex tasks with a limited range of possible solutions	Integrated contributions to professional practice and management of other users	Evaluation and creativity

According to the classification of digital skills used by the International Telecommunications Union [9] in the process of analyzing the state of the global telecommunications / ICT sector and monitoring the information society, basic, standard and advanced digital skills are distinguished.

Basic skills: sending emails with attached files; Copy or move files or folders Use copy and paste tools to duplicate or move information within a document. Transfer files between your computer and other devices.

Standard skills: connection and installation of new devices; creating electronic presentations using presentation software; use basic arithmetic formulas in spreadsheets, search, download, install and configure software.

Advanced skills: writing a computer program using a specialized programming language.

Different approaches to the classification of digital competence levels complicate the comparability of the obtained research results on the development of digital competencies both at the national level and in international comparisons.

Strategic directions for the development of digital competencies in the context of digitalization of the economy

Theoretical and scientific-practical generalizations and assessments contributed to the development of a model for the formation and actualization of needs for the development of digital competencies (Figure 1).

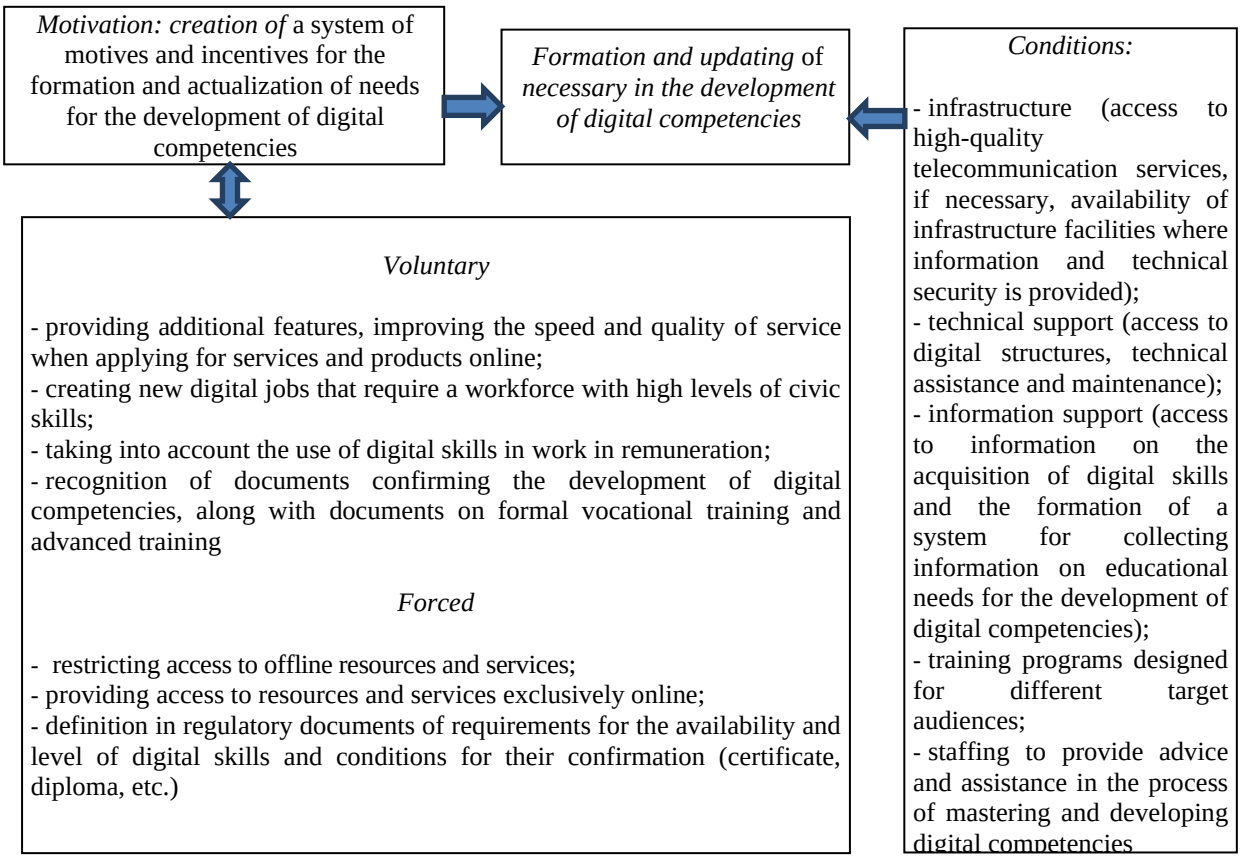

Figure 1.6. Model of formation and actualization of needs for the development of digital competencies

Source: [27]

It includes the following components: needs, conditions, motives and incentives, voluntary and coercive measures aimed at the formation and actualization of these needs. The terms mean information and technical support, infrastructure, educational products, consulting support. When meeting the request for acquisition and development of digital skills, it is important to take into account the age of the audience, locality (rural, urban, not controlled by the Ukrainian authorities territory, territory close to the demarcation border), level of digital skills, level of education, specific need that formed the request for training, status and sphere of employment. When forming the need for the development of digital competencies, a significant role is played by the state, employers, various business entities that restrict or terminate offline access to benefits, services, consultations or provide exclusively online access to them.

Limited access during the pandemic to offline administrative services, banking services has updated the acquisition of digital skills by the population to obtain information from websites or applications, submit information to government agencies or services online, information on the consumption of utilities and their payment, download and print official documents and payment documents. A separate challenge for internally displaced persons of retirement age was mastering the "Dii vdoma" application in conditions of poor-quality Internet connection when living in rural areas or in summer cottages.

Thus, restricting offline access or exclusive provision of access to benefits, resources, services, online work, in particular as a result of automating the provision of public services or creating digital jobs, creates the need to develop digital skills for both employees and consumers. An effective measure that does not restrict the rights of citizens to choose and access public services, but contributes to the choice of online consumption of services, is to provide additional opportunities, increase the speed and comfortable conditions of service when applying online for services and products. Employers have a wide range of tools for actualizing the need for the development of digital competencies of employees both at the stage of recruitment, selection, selection of personnel, in particular in the process of developing workplace models and requirements for candidates and the list of necessary documents for a vacant position to participate in the competition, developing job descriptions, and in the process of using, training, stimulating, promoting personnel by including in the provisions and plans the mandatory availability of digital skills and a document on the development or level of digital skills.

Creating the necessary conditions and implementing tools to motivate the actualization of needs for the development of digital competencies will overcome the main barriers to their acquisition: irrelevance of training and lack of interest in educational products and limited access to the Internet and devices.

The use of digital, ICT technologies by employers, the development of digital skills and competencies of employees create conditions for the accumulation of human capital in the country, the production of innovative products (services).

Innovative products (services) are associated with the use of new approaches to staff motivation, namely a combination of competence and digital.

The competence approach involves material remuneration, development of professional qualities (skills, competencies) of staff; recognizes the employee as the main value of the company, ensuring the competitiveness of both the employee and the company. Therefore, its use ensures the accumulation of human capital and harmonizes the interests of the employee with the strategic goals of the company. At the same time, the information economy determines the movement of jobs into the information space. It is possible to ensure the coherence of the interests of staff and the organization under such conditions using a digital approach to its management.

The digital approach involves the transfer of social and labor relations into the digital space, that is, the interaction between employees and between the employee and the employer online using digital devices; is based on the use of digital personnel management systems. It becomes more relevant with the advent of virtual offices. For example, Sococo, Workplace platforms that create a single information space for a digitally distributed team. Thanks to modern virtual offices, distributed teams can collaborate remotely on the implementation of complexCTs[15]. Therefore, the digital approach simplifies and speeds up the communication system both within the enterprise and with stakeholders. Competency and digital approaches are closely interrelated and complementary, both emphasizing intangible incentives; stimulate the improvement and development of digital competencies of employees, motivate to professional development.

The specificity of employment in the digital economy is that it is aimed primarily at accumulating personal human capital and is characterized by a high level of freedom of choice and mobility. The blurring of the line between work and leisure forms a new model of work, in which the favorite thing for a smart worker becomes more important than entertainment. Such a model requires new approaches to the formation of a model of motivation. The best option is to combine a competence approach with a digital one.

The state policy has significant strategic potential to ensure the effectiveness of digital skills acquisition by the population through the adoption by the Cabinet of Ministers of Ukraine of Digital Literacy Programs (Resolution No. 849 of 29.09.2019). The main implementing entity of the Program is the Ministry of Digital Transformation of Ukraine. The activities of the Ministry should ensure the achievement of the following goal: "A Ukrainian who wants to have digital skills, can acquire them freely." Indicators of the effectiveness of its implementation are determined: more than 6 mln. Ukrainians will be covered by the digital skills development program; 70% of citizens who have completed the program will have skills at a basic level. To achieve this goal and implement the Program, the Ministry of Digital Transformation of Ukraine launched a national online platform on digital literacy of the population of Ukraine [16].

International comparisons on innovation capacity, digital literacy, digital skills, etc., are driving countries to lead. Of particular interest are the components of the Competitiveness Index "innovation capability" and "skills", as they reflect Ukraine's position on the quality of personnel and the level of readiness to develop and implement innovations.

The indicator "capacity for innovation" includes a country's position on the quantity and quality of formal research and development; the level of favorable environment in the country in establishing cooperation, interaction, creativity, diversity and confrontation; the ability to turn ideas into new products and services. According to this indicator, Germany is leading (86.8 points), and Ukraine (40.1 points) is ranked 60th, which is 2 positions lower than in 2018 [17]. The indicator of "skills" assesses the quality of the workforce, as well as quantitative and qualitative indicators of the country's educational system. In particular, attention is focused on the development of digital literacy, interpersonal skills and the ability to think critically and creatively.

In terms of skills, Switzerland leads in the ranking (86.7 points), Ukraine scored 69.9 points and took 44th place, which is two positions higher than in 2018 [17]. When comparing the results of Ukraine with the indicators of Poland according to the

above indicators, it should be noted that the latter territorially borders on Ukraine, belongs to the post-Soviet countries and is characterized by a more developed economy. According to the Global Competitiveness Index, Poland ranked 37th. The analysis of the components of the "skills" indicator shows that in many components Ukraine has positions higher than Poland. This indicates the availability of skilled labor and labor potential.

According to the Report [9], there are significant differences in the level of digital skills between generations, in particular, the gap in basic skills reaches 30 percentage points, in standard skills – 40 percentage points. This digital skills gap by age category leads to the strengthening of state policy on the implementation of special digital literacy programs for older people and the dissemination of "Digital Entrepreneurship" programs for different age categories.

A new direction that will be possible thanks to the 5G network is the Internet of skills, which allows people to interact in real time over long distances – both among themselves and with machines. An example of the application of the Internet of skills is remote interactive learning through a combination of machine interaction methods and the expansion of communication capabilities [18]. Such systems realize the possibility of human interaction with a robot, virtual devices, artificial intelligence.

Flexible employment, which is actively expanding in the context of digitalization of the economy and quarantine restrictions during the COVID-19 pandemic, provides more opportunities for self-actualization and provides for high requirements for the educational and qualification level of employees. It should be emphasized that in all countries there is a steady tendency to increase the share of highly skilled category of workers in the structure of employees. Recently, as a result of digitalization processes, a digital economic space has been formed, which requires other mechanisms of interaction between labor market actors and other skills from employees. This determines the need for workers to master digital skills. At the same time, a digital skills gap is being created between employed and unemployed persons (according to a report by the International Telecommunication Union (ITU) in the world) [9].

In general, regardless of the status of a person in the labor market, the share of those with basic skills is higher than those with standard skills [9]. It is quite expected that the unemployed are lagging behind in all ICT skills, in the future the gap can only grow. Basic and standard skills are easy to master, but they are not needed if a person has the status of unemployed. At the same time, digital skills are a prerequisite for those who are self-employed or self-employed.

Possession of digital skills is a component of an individual's competitiveness in the labor market. They are especially relevant for freelancers, as many jobs have gone digital and can be done at home or in a public space. This implies the constant updating of digital skills. However, all risks regarding the timeliness and completeness of mastery are borne by self-employed persons, unlike those who are employed. This is facilitated by increasing the level of access to the Internet for households, which, according to the report of the International Telecommunication Union (ITU) in the world in 2018, was 60% [9].

According to the forecasts of the Institute for the Future (The Next Era of Human-Machine Partnerships, 2017), citing the US Bureau of Labor Statistics, modern students will change 8-10 jobs by the age of 38, and a significant part of them will join freelancers. It was expected that by 2020 the number of freelancers in the United States will reach 50 million people [19]. This is due to the fact that the actual work activity is becoming more mobile and flexible. It can be assumed that the number of freelancers will increase due to an increase in digital employment due to increased mobility, primarily digital. The Internet through mobile devices connects not only people with each other, but also people with technical accessories.

There is a digital gap in the skills of the population depending on the level of development of the country, which is associated with the branching and accessibility of digital infrastructure for the population. At the same time, the share of the population, particularly in the least developed countries, that has an Internet connection is constantly increasing. The data of the Report [9] show a significant lag in the population of the least developed countries (LDCs) in basic and standard digital skills by 19 and 20 percentage points respectively. At the same time, LDCs

have people with programming skills. It should be noted that a small part of the population of both developed and least developed countries has mastered advanced digital skills. It can be assumed that with the development of information and communication infrastructure in LDCs and ensuring wide access to it for the population, as well as corresponding prices for digital devices, the share of the workforce with digital skills will increase.

The development of digital technologies puts forward new requirements for the educational, qualification and professional level of human resources, thereby developing innovative human capital. Carriers of innovative human capital have a high level of intelligence and digital skills, but this is not enough. The competence of an innovative worker is determined on the basis of the thesis "a person should be smarter than a computer", that is, an employee must combine intuitive and logical thinking, produce innovations, be able to make unprogrammed decisions, learn quickly, easily assimilate new technologies and produce new knowledge. According to T. Frey's forecasts, by 2030, more than 2 billion "traditional" jobs will disappear in the world, which will replace the new ones demanded by the digital society [20]. He identifies 14 skills needed in a new society, including: the ability to adapt to a new environment, find problem points, develop effective feedback mechanisms, new theories, establish processes, etc. T. Frey has developed a classifier of 162 new future professions for the preparation of vacancies that do not yet exist in 11 areas of activity in the digital society [21]. Skills for these professions can only be formed using digital technologies for training specialists.

Every year, the pace of skills aging is accelerating due to changes in technology and digitalization. Solving this problem requires the expansion of lifelong learning. This concept is becoming even more relevant in the context of the formation of the digital economy, due to fundamental changes in the process of labor and business processes. The concept of lifelong learning should be implemented within the framework of the strategy for the development of smart specialization. Constant updating of existing skills and mastering new ones is a necessity for the carrier of human capital, as it provides support for the level of its competitiveness. The concept

of lifelong learning is implemented in the form of formal, informal and informal learning. Higher education institutions can offer all types of education or a combination of them. In particular, universities can offer non-formal education through the placement of their own courses on educational platforms or other open resources, as well as through seminars, trainings, workshops, hackathons. A person acquires information education through self-study during professional, social activities, etc. An educational institution may participate in public, cultural and other events held in the region.

The results of an expert survey [12], conducted by specialists from the Institute of Industrial Economics of the National Academy of Sciences of Ukraine, show that the national system of formal education partially ensures the formation of digital skills. The main disadvantages are the use of outdated technologies in the education system and its lagging behind the pace of development of digital technologies, the inconsistency of educational standards with professional ones.

This involves the implementation of the following measures:

- monitoring the need for personnel with digital skills and establishing the level of met demand (executors: State Employment Service of Ukraine in cooperation with IT clusters, IT companies);
- introduction of adult education for mastering basic and standard digital skills (executors: Ministry of Education and Science of Ukraine, State Employment Service of Ukraine, Ministry of Social Policy of Ukraine, volunteer organizations); introduction of digital entrepreneurship trainings into higher and vocational education (executor: Ministry of Education and Science of Ukraine);
- spreading the culture of digital entrepreneurship among the population;
- implementation of the programs "Digital literacy" and "Digital entrepreneurship" for persons who have the status of unemployed and are trained with the assistance of city and regional employment centers (executor: State Employment Service of Ukraine);
- implementation of digital entrepreneurship support programs (executor: State Employment Service);

- supporting the implementation of teaching practices in educational institutions on a mixed basis using ICT (executor: Ministry of Education and Science of Ukraine);
- harmonization of professional and educational standards taking into account the digital needs of the labor market, formation of models of employees' competencies for sectors of the digital economy.

The development of a model of competence of employees in a particular area is closely related to the content of standards of professional activity. The structuring of the content of the professional standard is based on a competence approach, which involves the formation of requirements for the knowledge and skills of the employee, ensuring the quality performance of the main labor functions in the relevant field of professional activity. The structural elements of the professional standard are labor functions, professional competencies (by labor action or group of labor actions), general competencies, subjects and means of labor, requirements for knowledge and skills of the employee, etc. [23].

According to the Methodology for the development of professional standards [23]:

professional competences – a set of knowledge, skills and abilities, professionally significant qualities of a person that ensure the ability to perform at a certain level labor functions defined by the relevant professional standard;

professional standard – approved in the established line requirements for the competencies of employees, which serve as the basis for the formation of professional qualifications;

General competencies 2012 universal competencies that do not depend on the subject area are important for the successful professional and social activities of a person.

The competence model includes the analysis of work functions and the definition of abilities that are required for their implementation, followed by grouping them into thematic blocks and filling them with competencies.

The whole set of learning outcomes forms a model of competence. All models of competencies of modern employees should include digital competencies, including skills in using information and communication technologies, the ability to search, process and analyze information from various sources. The current Methodology for the development of professional standards should be adjusted to include digital competencies in their general list in the Sample design and content of the professional standard in subsection 4. "General competencies" for professions for which they are not professional competencies. The competence approach in the development of professional standards is focused on the direct use of professional standards in the formation of educational programs / standards and training modules (for example, one labor function - one educational program (one module), during the certification and certification of personnel, assessment and assignment of professional qualifications, when the level of competence (ability) of a person to perform one labor function or their set is established. Change of labor functions, labor actions of employees, objects and means of labor, requirements for knowledge and skills of an employee under the influence of digitalization of the economy in many industries require updating professional standards with subsequent updating of educational standards in accordance with the needs of the modern labor market.

Inconsistency of actions and non-observance of the order and priority in the development of professional and educational standards, their untimely updating lead to inconsistency of competencies of graduates of educational institutions with the needs and requirements of employers.

The model of competencies of an employee of the digital economy should serve as a criterion for the selection, hiring, selection and evaluation of personnel in order to rationally form the staff, and determine the list of those qualities of employees that need priority development. In accordance with this, it is necessary to develop appropriate programs for their effective training and advanced training.

Operating exclusively with the categories of "profession" and "digitalization" often leads to somewhat rough generalizations, which are limited only to conclusions such as "new profession", "obsolete profession" or "disappearing profession", while a

significant trend in the development of the labor market is the recombination of functions and demanded skills of the workplace and the position of the workplaces themselves within different types of economic activity. Modern intellectual analysis and big data allow you to process and operate not aggregated categories, but elementary information units, such as elements of competencies and skills, elements of functions and tasks of the workplace [24].

According to the European Training Foundation (ETF) [25], the most common among the vacancies are the requirements for the applicant to have personal qualities of adaptation / flexibility (77.4% of vacancies) and responsibility (53.0%), knowledge of economics and management (68.3%), skills of the user of office software (68.6%), as well as language competencies, teamwork skills, technical knowledge, basic skills of working with a computer, monitoring and leadership skills encountered in more than 40% of vacancies.

These data indicate the expansion of the range of vacancies that are concentrated in the segment of the digital economy and are directly related to the production, marketing, promotion of digital goods and services, e-commerce. First, these are vacancies intended for specialists in the field of programming and information technology. This is one of the most dynamic areas of activity in Ukraine. New here are the professions "big data specialist", "Java engineer", etc., which did not exist a few years ago.

Secondly, these are SEO managers, SMM managers, targeters, account managers, link builders, etc. These vacancies are specific, not typical for the labor market of the past, but the possibility of mastering the necessary competencies to perform garden duties usually does not require a second specialized higher education, it is sufficient to acquire additional competencies in related specialization through short-term professional training (courses, trainings).

In general, semantic analysis allows you to identify vacancies with meaningful names, which, according to their extended descriptions, cannot be attributed to well-known sections of the classifier of professions. The presence of such vacancies serves as an indicator of the formation and emergence of new professions on the labor

market, which is an extremely important result of applying the methodology for using big data for labor market analytics (identifying knowledge in big data) [26] for both scientific and practical spheres.

Accordingly, tracking the dynamics of the number of such professions allows you to identify new trends in the labor market and respond in a timely manner to such changes: from making changes to the classifier of professions to the possibility of forecasting the supply of new jobs in the labor market [24].

So, today big data specialists are in the top of the most common vacancies both in the world and in Ukraine. For the most part, competence requirements for them overlap with several areas of professional activity (economist, statistician, programmer), which implies higher education in one of the profiles and in parallel with professional experience or specialized courses in other professional fields. According to research, digital skills make up only 30% of the profile of a big data specialist, and non-digital and interpersonal skills make up 31% and 39%, respectively (Figure 1.7).

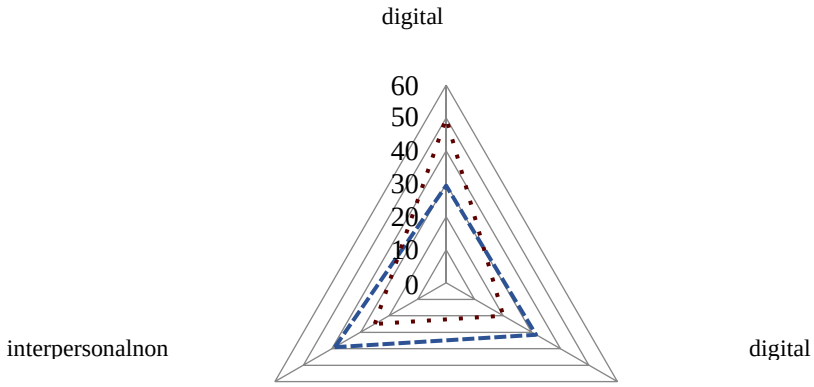

Figure 1.7. The combination of competencies for the profession of "big data specialist" (dotted line) compared to a specialist in programming (dot line)

Source: [25]

At the same time, as mentioned above, in Ukraine there is a clear tendency to complicate in the context of digitalization of certain types of professions, especially those that previously belonged to the simplest, strengthening their manufacturability

and content, which requires additional knowledge and skills from applicants. An example is the vacancy of a warehouse worker (storekeeper). Today, for an increasing number of these vacancies under the influence of the development of new automated accounting technologies and intra-warehouse logistics, the common requirements of employers are: knowledge of the principles of automated warehouse accounting, PC skills, knowledge of 1C, features of transportation of certain types of products.

The analysis of the section of "competence professions" demonstrates the spread of a segment of vacancies that require multiversatility of employees, and sometimes mergers, combining activities that were previously considered exclusively as separate professions. This is manifested in the emergence of such vacancies: administrator-accountant, driver-loader-forwarder, inspector-picker, accountant-specialist in personnel management, marketer-sales representative, etc. The emergence of this trend in the Ukrainian labor market is caused, firstly, by the global tendency to increase the multifunctionality of specialists and competence in solving complex problems, which is associated with the general tendencies of complication of mental labor activity, the introduction of new digital technologies and the gradual reduction of the able-bodied population, and, consequently, skilled labor; secondly, the intersection and increase in the interdependence of various forms of activity, which has caused the need to search for specialists whose competencies will be at the junction of various forms and spheres of work.

The above examples of using big data on the labor market illustrate that such methodological approaches can help find answers to special and specific questions, in particular about the impact of digitalization of the economy on competencies and their combinations, the emergence of new professions, understand the expectations of the labor market by studying its demand for professional skills rather than skills listed in standard job descriptions, as well as develop substantiated proposals for improving labor market and field policies in Education. The formation and justification of models of competencies by professions in the digital economy should take place with

the mandatory use of the results of the analysis of big data on the labor market and in accordance with its needs.

The general scheme for assessing the impact of digitalization of the economy on the demand and supply of jobs is shown in Fig. 1.8.

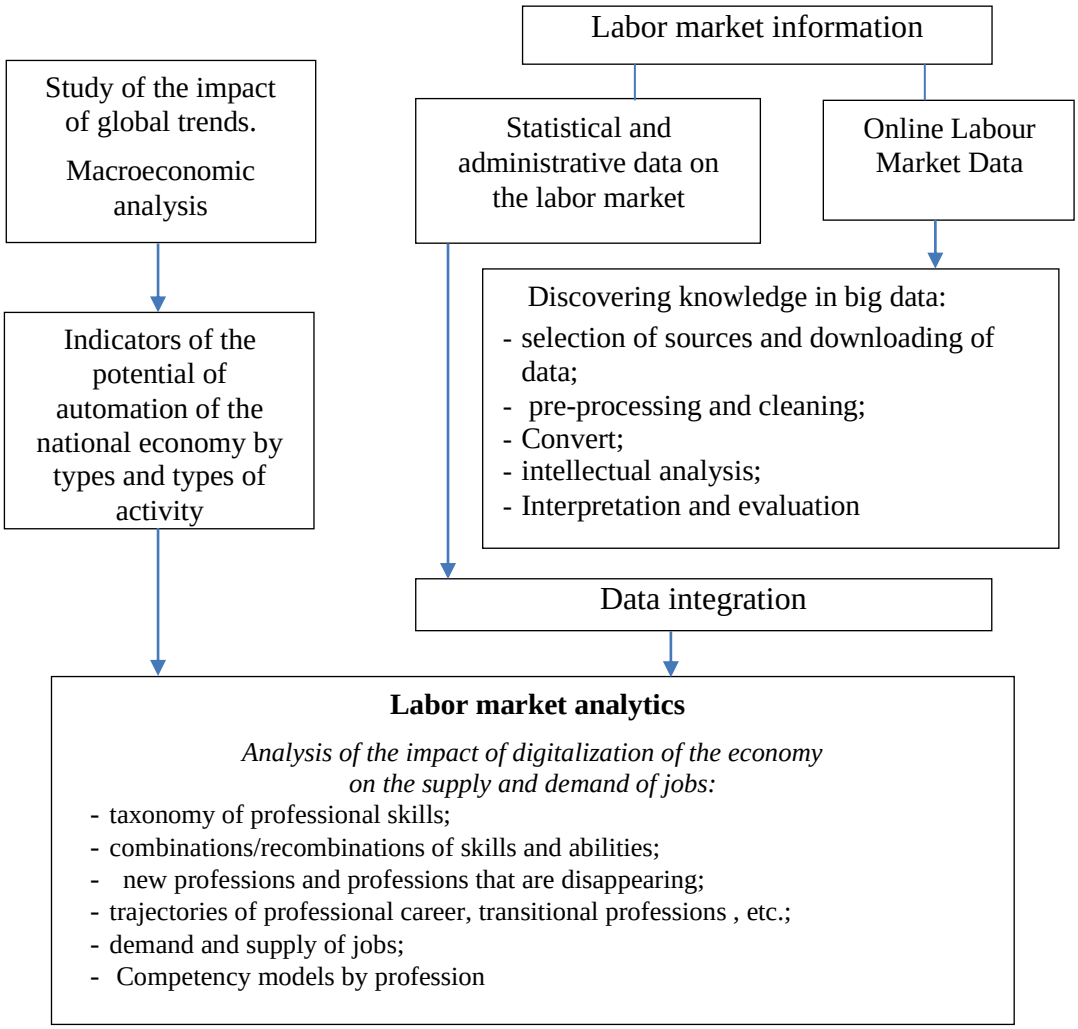

Figure 1.8. General scheme for assessing the impact of digitalization of the economy on the demand and supply of jobs

Source: [28]

Therefore, in the process of research, the classification that exists in the EU was studied, which contains three main categories of DSC for students/citizens: digital competence; special digital skills; digital skills for ICT professionals. The main areas of competence of DigComp have been systematized. A Model of the formation and actualization of needs for the development of digital competences has been

developed, which includes the following components: needs, conditions, motives and incentives, voluntary and compulsory measures aimed at the formation and actualization of these needs. The main strategic directions for the development of digital competences in the conditions of digitalization of the economy have been developed. A general scheme for assessing the impact of digitalization of the economy on the demand and supply of jobs is proposed. Methodological approaches can help to find answers to special and specific questions, in particular about the impact of the digitalization of the economy on competencies and their combination, the emergence of new professions, to understand the expectations of the labor market by studying its demand for professional skills, rather than the skills listed in typical job descriptions, as well as develop reasonable proposals for improving the policy on the labor market and the field of education.

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CHAPTER 2
THE DEVELOPMENT OF INNOVATIONS IN THE DIGITAL ECONOMY

DIGITALIZATION AS AN INNOVATIVE MODERN FACTOR BUSINESS DEVELOPMENT: PROSPECTS AND THREATS

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Citation:
Panchenko, V. & Dovhenko Ya. (2023). Digitalization as an innovative modern factor business development: prospects and threats. *The development of innovations and financial technology in the digital economy:* monograph. OÜ Scientific Center of Innovative Research. 2023. 230 p. PP. 87-106, https://doi.org/*10.36690/DIFTDE-2023-87-106*

Abstract. *One of the most influential modern trends is the active development of innovations and modern information technologies, which gradually acquire the status of a key driver of the development of economic relations, correspondingly affecting the features of ensuring economic security not only in the context of development prospects, but also on the contrary, regarding the need to form appropriate warning systems and protection against digital threats. The rapid introduction of scientific and technological progress at the enterprise made it necessary to make digital transformation a priority. Every year, it becomes more and more difficult for companies to become competitive and gain a foothold in the market without the use of artificial intelligence and various services. A few dozen years ago, humanity did not think about the need for such a term as "digitalization". However, the development of means of communication and innovative technologies has become a decisive factor for the introduction of digitalization at the enterprise. The digitization process is the implementation of digital innovations and technologies for the automation and optimization of business processes, as well as the improvement of communication channels between the enterprise and its consumer as a result. The aim is to obtain scientifically based economic solutions for the introduction of digitalisation into the management structure of enterprises to optimise investment attraction in the context of financing the innovation activity of enterprises, which determines the relevance of the article. The chapter of monograph analyses the prospects and obstacles for the development of business digitalisation in Ukraine. In particular, significant attention is paid to the use of SWOT analysis for a deeper understanding of the main problems and prospects of digitalisation in the country. The results of the study deepen the theoretical knowledge of the impact of digital technologies on business models. The results of the study can be used by senior management and business developers, as a clear definition, examples and tools facilitate the DT of business models. These stages of digital transformation enable companies to take advantage of the potential of digital technologies (e.g. sensors, big data) and rethink their business model. By applying these stages, companies can optimise their current BM and create a clear competitive advantage.*

Keywords: *digitalization, innovation, information technology, consumerism, development, transformation.*

Every year, digital transformation takes a more important place in modern society, which has led to the emergence and spread of the concept of "digitalisation". "Digitalisation is a general term for the digital transformation of society and the economy. It describes the transition from the industrial era and analogue technologies to the era of knowledge and creativity, characterised by digital technologies and digital business innovation," Innolytics' definition reads. Digitalisation is penetrating almost all industries and services, bringing about important changes in the management of companies, making them more flexible and competitive in today's market. Digitalisation opens up many new opportunities for organisations to develop effectively and is an effective mechanism for implementing positive trends. Therefore, the development and implementation of digital strategies will help business organisations adapt to the growing pace of digitalisation and ensure their sustainable development. The term "digitalisation" comes from the English word "digitalisation", which means digitisation. Literally, digitalisation is the process of transferring information into a digital format, i.e. converting paper carriers into electronic ones, photographs into images on a screen. However, digitalisation is not limited to this. Digitalisation is a necessary process for the development of modern enterprises in the neo-economy. It is designed to simplify and speed up the work with large databases, and to automate all types of activities. The need for digitalisation is driven by the desire to continuously improve the competitiveness of business organisations, which in turn is a prerequisite for their survival and development in the neo-economy.

The dynamics of innovation processes is one of the key indicators of the financial position of companies operating in the market. Innovative processes are carried out through the introduction and use of new equipment, technological processes, high-quality raw materials and products, and new methods of production organisation. In the context of network interaction, the innovation process becomes open, manifesting itself in the form of combined efforts of start-up companies, industry consortia, as well as consumers, suppliers and intermediaries. This process

leads to the formation of cooperative chains by intensifying ties between partners and participants in the process. The modern digital model is supported by stakeholders.

The first is the state, which performs the functions of sectoral regulation, setting rules and regulations, providing support to industries, and encouraging industry leaders to switch to the digital paradigm. It is also supported by powerful enterprises in the industries: the formation of an expert community and a database of information resources and providing access to them for the development of digital services; innovative companies that drive the emergence of new digital products and services. Business development depends on many factors, but all market participants will have to change much faster in terms of digital transformation than they are doing today. The changing external environment requires a company to constantly comply with all global trends and standards, to ensure competitive advantages that will allow it to maintain its business operations for a long time and stably. The feasibility of digital transformation is determined by the speed and understanding of consumers in establishing a system of effective communication flows. The rapid and modern development of information, communication and digital technologies facilitates their integration into all sectors of the national economy. All sectors of the national economy are being modernised on the basis of digital technologies, opening up new business opportunities.

Thus, the formation of a new economic space makes it possible to create and sell competitive products and make effective management decisions. Thus, the main goal of the national digital economy is to create new opportunities for the development, modernisation and optimisation of all economic activities based on digital infrastructure.

Businesses that follow the latest trends in digital innovation and are ready to implement them, and are able to adapt to more flexible business processes, have a great potential for success

There are many definitions of the term "innovation" in science. The concept of "innovation" is generally accepted in the scientific community. Taking into account the achievements of researchers, project management as a way of innovative change

requires a deeper analysis based on the theoretical foundations of project management.

Studies of the issues of innovation theory and project management can be observed in the domestic scientific space in the publications of A. Amosha, V. Heits, S. Ilyashenko, O. Kuzmin, A. Cherep, etc. At the same time, publications on the topic of innovation project management in scientific research and official regulatory documents (European Commission, World Bank, European Bank for Reconstruction and Development) appeared as a result of a combination of project management (in particular, in terms of investment), which was formed in the 1950s of the twentieth century, and J. Schumpeter's innovation theory [1]. But, unfortunately, the current direction of digitalisation as a factor of business development prospects and threats is partially covered.

The aim is to obtain scientifically based economic solutions for the introduction of digitalisation into the management structure of enterprises to optimise investment attraction in the context of financing the innovation activity of enterprises, which determines the relevance of the article.

The article analyses the theoretical basis of the digitalisation of the economy as a whole, and considers the key methods of enterprise transformation. The presented results can be used during the transformation of an enterprise and optimisation of business structures for the implementation of innovative projects and tasks.

The rapid introduction of scientific and technological progress in large companies has made digital transformation a priority. The notion of digital transformation is often confused with automation or even digitisation of data. However, this is only part of the digitalisation process, i.e. digital transformation. As technological capabilities and the volume of information increase, it becomes clear that the data collected and the automation systems themselves have not yet brought a positive effect. They currently require resources, time and effort, attention and maintenance. Over time, attention will be paid to building more efficient modern processes, using new technological capabilities to contribute to the development of business and society in a powerful way.

The digital economy is a global network of economic and social activities that are carried out through the global Internet, as well as mobile and sensor networks. It is an economic model based on Internet access. This means opportunities to increase labour productivity, competitiveness of the enterprise, and reduce production costs. In the digital economy, human needs can be met better and more efficiently.

The successful functioning of the digital economy requires three elements

- infrastructure, including Internet access, software, and telecommunications
- e-business (conducting business activities via computer networks)
- e-commerce - the sale of goods and services via the Internet;

The development of business digitalisation is linked to the development of access to the general Internet and telecommunications. However, such "communication channels" are of no value if humanity does not use the latest information technologies.

Every year, it is becoming increasingly difficult for companies to become competitive and gain a foothold in the market without the use of artificial intelligence and various services. A few decades ago, humanity did not think about the need for such a term as "digitalisation". However, the development of communication tools and innovative technologies has become a decisive factor for the introduction of digitalisation in the enterprise [3]. The process of digitalisation is the introduction of digital innovations and technologies to automate and optimise business processes, as well as improve communication channels between the enterprise and its consumer as a result. The term "digitalisation" comes from the foreign word digitalisation, which means "digitisation". Literally, this term can be translated as "the process of transferring information into digital form". Automation means making a process less dependent on the human factor without changing the essence of the process. That is, an established workflow is described using a certain algorithm and then transferred to a digital format. It can be implemented by writing software packages or robotic systems. In this case, some of the functions performed by humans are transferred to the system. Digital transformation includes the following key aspects:

1. External communication. The model of building relationships with customers and partners needs to be rethought. The model where companies create a product that is convenient for them and then try to convince the client that this is what they need to buy is becoming ineffective. You need to prepare a product for a specific client, their needs and consumption situation. And this requires appropriate communication processes [2].

2. Business model. Many giant companies that have been successfully operating for decades on stable business models have collapsed on the threshold of the digital era. Modern business models imply flexible customisation both to the client and to circumstances and situations. The business model is becoming a sharing model rather than a commodity model, and it is becoming omnichannel rather than imposing its own channel on the market. "Sharing" is the English word for "to share". This is the Collaborative Consumption economy or sharing economy, which is the name of an economic business model where people can use technology to exchange values that they do not use. As part of the digital transformation, a significant rethinking of the actions of business management is underway [5].

3. Project processes. Today, traditional businesses use project management. However, less than 1% of the projects launched in Ukraine become commercially successful, with slightly higher figures in the IT sector. These figures largely explain why it is difficult for businesses to survive today. In contrast to project management, new businesses are switching to Agile and Lean technologies, or flexible change technologies. This helps to avoid most problems.

4. Lean production - management seeks to minimise losses on an ongoing basis. It involves every employee in business optimisation and is as customer-oriented as possible[6].

5. Working with data - rethinking. Previously, data management was structured as follows: a layer of data for previous periods was accumulated, then analysed, reports were prepared and decisions were made on their basis. Extrapolation was done: future development was calculated on the basis of past periods. Nowadays, the way we work with data is different, it's not just BigData anymore, today deep

machine learning, the use of artificial intelligence allows us to make decisions in situations with incomplete and asymmetric information [8].

6. Internal communications and relationships. In the context of digital transformation, it is necessary to build a different way of working with people. Remote work, outsourcing and freelancing are emerging.

As a rule, today's business organisations are not yet using all the directions and opportunities of digitalisation. Most often, they adopt only certain digital technologies, which leads to a delay in digital development and therefore reduces their competitive advantages. As noted by Guseva E. O. and Legominova S. V., the process of digitalisation can take place in three stages [1]:

1. Analysis of the company, goal setting and strategy development.

2. Implementation of digital technologies.

3. Analysis of the results.

In other words, you first need to analyse all business processes and strategic capabilities of the company, namely: determine the effectiveness of departments, internal and external communications, and analyse how digitalisation can improve them. In order to minimise risks, it is necessary to formulate a strategy in which new technologies should not fundamentally change business processes, but only simplify and improve them. In order to implement the plan, you need to either build a team of employees or engage external specialists. It takes a lot of time and financial resources to introduce new technologies - testing, fixing technical errors, training staff - and to implement them. After the implementation of each digital solution, a detailed analysis of the effectiveness and profitability of these innovations is required [3]. It should be noted that business digitalisation is a new creative process, an organisational innovation, and therefore there are no precise instructions for its implementation. Business organisations will have to face numerous mistakes and go through the process of rethinking the forms, directions, methods, and technology of using digital. An important pillar of digitalisation and the key to its success is the innovative climate in a business organisation and the corresponding corporate culture, a high

level of which is necessary for reliable communication between all levels of management in order to quickly implement changes [2].

According to a survey of senior executives, seven main obstacles to the implementation of digitalisation in practice have been identified, in particular [6]: low level of staff competence, lack of qualified personnel, lack of strategy, fear of change, insufficient funding, management position, and risk.

Digital transformation is the use of modern (disruptive) technologies to increase the productivity and value of an enterprise in the modern world. The main results of this transformation can include cost reduction, improved quality of services and products, and increased productivity. KPMG's research shows that 61% of companies have seen digital technologies increase competition in their business from new players. Today, 44% of companies worldwide have a digital development strategy. Digital transformation of a business model can take place at the level of its individual elements or the entire business model. The degree of DT includes consistent (marginal) or radical (fundamental) changes in the BM. The benchmark for the level of novelty is primarily the client, but DT can also affect its own business, partners, industry and competitors. As part of the digital transformation of a business model, tools and technologies (e.g., big data) are used to create new applications or services [7].

These factors require skills that enable the collection and exchange of data, as well as the ability to analyse, calculate and evaluate options. The estimated parameters are used to initiate new processes within the business model. Business model transformation is based on a sequence of tasks and decisions that are linked in a logical and temporal context. It affects four target dimensions: time, finance, space, and quality [8]. In 2017, German economists D. Schalmo and K. Wilms developed a sequence of stages (phases) of digital transformation of BM based on approaches to DT and existing theories on business model innovation. Let us consider the sequence of stages, their tasks and implementation measures in more detail.

The first stage is Digital Reality, where the company's existing business model is identified along with a value-added analysis, related and stakeholder analysis, and

a review of customer requirements. This provides an understanding of the digital reality for that company in various areas. The next phase is the Digital Ambition: based on the previous Digital Reality phase, the main goals for transformation are defined in terms of time, finance, space and quality. Digital ambition postulates which goals should be considered for a particular business model and its elements [6]. The third phase is Digital Potential, which identifies best practices and factors that contribute to the development of digital transformation. This serves as the initial stage in terms of digital potential and design of the future business model. For each element of the business model, different logically combined options are developed. The fourth step is Digital Fit, where the digital business model design options are analysed, evaluated and compared with the existing business model [9]. The final stage is Digital Implementation, which includes the finalisation and implementation of the developed digital business model. Design options are being developed as part of the digital implementation. The phase also includes the development of a digital customer experience and a digital value chain describing integration with partners. Resources and capabilities are also identified at this stage.

Each of the categories includes a set of specific activities and services, such as Digital Data: the collection, processing and analysis of digitised data to facilitate and improve forecasting and decision-making. Automation includes a combination of classical artificial intelligence technologies that enable autonomous operation and self-organisation. This reduces errors, increases speed and reduces operating costs [7].

Digital Customer Access tools are mobile Internet that provides direct access to the customer, ensures a high level of transparency and the provision of new services. And the last set of tools is Networking: a mobile or wired network of the entire value chain using high-speed broadband telecommunications enables synchronisation of supply chains, which leads to shorter production times and innovation cycles. The above list of tools can be supplemented with more capabilities and services if necessary. An example of additive manufacturing is the production of bionic aircraft components[11].

In July 2014, Airbus installed a bionic bracket in an A350 aircraft and flight tests were successful. This component was 3D printed from titanium powder and had the same characteristics in terms of function and strength as a conventional component.

The main advantages of such production are: - reduced material consumption and weight of the component (30% lighter); - reduced fuel consumption; - increased inventory flexibility, as Airbus can "print" spare parts on site according to original specifications, without depending on large production facilities or delivery expectations [9].

The impact of digital technologies on manufacturing firms is also significant, as robotics, automation, 3D printing, sensors and digital platforms will enable a fourth industrial revolution that will lead to a fundamental change in the economy that goes beyond the traditional trade-off between scale and customisation. This revolution is disrupting the traditional ideas that drive globalisation by enabling instant, low-cost local production. The challenge for industrial enterprises is twofold: to quickly embrace digital broadcasting, following GE's example, and to embrace disruptive change [8]. The above business models are most susceptible to the impact of digital technologies. However, in other sectors, digital technologies are driving companies to develop new business models (e.g. Amazon's move to cloud services) or to completely transform their business models (as IBM has done, moving from products to services and now back to analytics) [10].

Businesses that welcome and embrace change and are able to adapt to more flexible working models have a great potential for success. The main advantages of digitalisation are: maximising process optimisation, increasing earning opportunities by focusing on the customer.

Process optimisation involves reviewing the possibilities of building a flexible, self-adjusting system that can be further adapted to different conditions. Eliminating routine allows you to use your human resources more efficiently. The emergence of new technologies opens up new opportunities and profit options that were previously unavailable. It is digitalisation that focuses businesses on customer needs. The

customer is the main source of income, information and inspiration - an incentive to move forward. But in order to create the right product, you need to have information about the customer's needs at each stage of interaction. Moreover, this transformation is repeated. You need to constantly learn, transform and be open to change.

Factors affecting the transformation process:

- Concept. At the start, it is very important to determine the direction of development. You need to develop a strategy, an action plan, and a Roadmap. Identify goals, resources and priority areas for modernisation. In the process of developing the concept, all business processes will be considered, priorities will be set and obstacles to successful implementation will be removed.
- Staff training. There is one very important point from sociological research here, namely that in Ukraine, only 4% of people are ready to move into a new era and experiment, while 88% prefer comfort, security, stability and proven solutions. This means and is confirmed by practice that most employees will resist change, sabotage and try to demonstrate the failure of solutions and innovations. Therefore, it is at this point that employee-driven management, a human-centred approach to management, should come to the rescue. Therefore, successful digitalisation requires preparing employees for changes in work processes, accustoming them to flexible decision-making, and teaching them new technologies so that they can not only work effectively in the new environment but also become drivers of further change. Such readiness implies the ability to think creatively, knowledge and the ability to make effective decisions.
- Rejection of outdated technologies means rejection of technologies that actually consume resources and freeze business in a static connected state; of old stereotypes, habitual patterns of action. Such a competitive technology no longer helps to survive, and it is necessary to act on the principle of combining efforts.Розвиток цифрової економіки пов'язане з розвитком доступу в Інтернет і телекомунікацій. Але самі по собі такі «канали зв'язку» не мають цінності, якщо люди не будуть використовувати технології.

Before the outbreak of the pandemic, the virtual and traditional economies of the world lived separate lives that hardly intersected. Now they are likely to be forced to come together to create some kind of hybrid organisation that would be much more resilient in today's reality. Companies that saw certain opportunities in digitalisation but were unable to exploit them due to a lack of urgency are likely to move in this direction today. An example is the banking system. Not so long ago, the world's first completely unmanned bank branch appeared in one of the wealthy Gulf countries. This is the direction of the industry's digital transformation. Online banking, on the other hand, is booming in Africa, effectively moving bank branches to smartphones. Obviously, it is much more resilient to pandemics and quarantine than traditional banks as we imagine them, even if it is developing most rapidly in poor countries that are less prepared for a pandemic. In Ukraine, traditional banking has been developing alongside its digital version. But now, like the entire economy, it is going through difficult times, while online banking has received a new impetus for development, supported even by the regulator, the NBU. Recently, the agency allowed opening a bank account with a digital passport.

The coronavirus pandemic and the introduction of quarantine measures in many countries have partially changed the world's view of digitalisation. Many global thinkers have talked about digitalisation as the future of humanity and even a way to solve global problems such as COVID-19. They believe that due to the pandemic, the speed of informatisation will increase dramatically, and this will lead to a kind of digital leap of humanity, thanks to which the "digital" will penetrate all areas of human reality. Of course, they are right to some extent. But this view was formed under the influence of pandemic uncertainty and self-isolation in quarantine. It does not take into account some of the constraints on further development, such as the war in Ukraine, which should not be forgotten and some adjustments should be made.

Indeed, the corona virus pandemic crisis has created and exacerbated a number of human needs, such as the provision of food and medicine, video communication or online learning. It has created or expanded certain niches in the economy. Capital began to flow into these niches, and people wanted to make money on it. For

example, the market for webinar software (Zoom, Webex, etc.) has grown significantly and become more competitive, which has led to an increase in the quality of the relevant services. But does this mean that these programmes will be part of our lives forever, as all work is likely to be transferred to a remote format? Digitalisation has not yet been able to solve the problem of company motivation. So, most likely, where there is no way to pay for projects and set deadlines, sooner or later, humanity will return to working in offices and factories. After that, there will be no need for mass video communication, so we can say that digitalisation in this area will take a step back.

The coronavirus crisis has revealed another crucial point. In today's environment, every strong business must have some sort of IT department. When all companies face this problem for the first time at the same time, it is not a big problem because not everyone can go bankrupt and many countries have taken on some burden. But if this happens again, those who do not learn from the 2020 quarantine will not be able to survive, and their place in the market will be taken by those who are able to learn and change. Perhaps we are entering an era of unfavourable natural and historical processes, and no one knows how many times this will happen again. A progressive company should be prepared for any scenario. This means continuing to exist in the Internet space and mastering digital technologies.

Only a large company has enough resources for digitalisation, at least to pay for a permanent team of programmers. Small businesses, on the other hand, cannot afford it. Therefore, it will have to withstand all situations that require the transfer of operations to the digital dimension. This is likely to widen the economic gap between small and large businesses, similar to the gap between field workers with horses and John Deere equipment with satellite navigation. Under such conditions, the positions of companies will be established with the corresponding consequences.

Despite the fact that the national economy has made positive changes in the direction of computerisation, the great potential of the digital economy has yet to be tapped. Domestic companies are not fully implementing the latest digital technologies. Compared to European countries, Ukraine's results in the development

of the digital economy are rather modest. First of all, this is due to the slow updating of the technical base of enterprises. However, it should be noted that the banking industry's automation capabilities are quite high, as evidenced by the active development of domestic payment systems. For the digital economy to develop more actively, it is necessary to study and implement the experience of European countries at the state level.

Along with growth opportunities, the digital economy also increases regulatory and identity risk. The digital economy implies a fully digital personal identity. This is both convenient and risky. There are official threats of "identity theft", i.e. official civil and consumer lawsuits, as well as illegal actions on behalf of others.

Despite the fact that digital technologies are quite widespread today, there is a lack of research on their "security". The threat lies in the possible hacking of digital systems with unauthorised access to personal data. The amount of personal data collected by Internet of Things sensors is growing, and this raises fears of privacy intrusion. The main issue is the lack of full consent to the collection and processing of personal data, as well as what data should be collected and how it should be analysed. This carries a risk of loss of privacy.

Risks of artificial intelligence. Recognising people from home and city video cameras, voice recognition and voice commands in personal voice assistants, responding to changes in the environment, analysing user preferences - all these manifestations of artificial intelligence are in great demand today. But at the same time, there are significant risks. There are many methods of misusing the principles and algorithms of artificial intelligence. In hacker attacks, artificial intelligence that serves criminals easily obtains a "captcha", i.e. easily proves that "it is not a robot", which allows it to conduct numerous unauthorised transactions on behalf of a business entity.

Risks associated with the use of blockchain. Blockchain technology is another interesting technology designed to penetrate the economy. In addition to the obvious advantages, the conversion of processes to blockchain also contains new threats. Blockchain platforms themselves, like any rapidly evolving software, are not perfect,

they have vulnerabilities that are further complicated by holes in the "smart contracts" that have already been created by third-party programmers developed on the blockchain platform. Therefore, today the digital economy is an effective basis for the development of the public administration system, the economy, the social sector and the entire society.

There is also a risk that not all segments of the population will be able to take advantage of the benefits of digital technologies due to the lack of access to modern digital connections and digital equipment, which may pose a threat to social cohesion and inclusiveness and lead to the emergence of social classes of the digital elite and digital outcasts.

Other risks include social risks. Progressive labour automation and the use of robotics may result in the replacement of physical/manual labour. Due to the introduction of digital technologies, most existing jobs may disappear and people will be forced to retrain to remain employable. There may be a "disruption" of the labour market, with consequences:

- the threat of structural unemployment due to the inability to adapt the required skills;
- a wage gap: digital technologies will require a higher level of skills to use them;
- less access to social guarantees (lack of social and health insurance packages) in online employment.

To identify the main obstacles to the digitalisation of Ukraine's economy, we will use the SWOT analysis methodology. This method directly allows us to systematise the main features of the development of the digital economy infrastructure as a complex system of economic relations and to rank them according to various substantive features. It is based on the search for, identification and systematisation of the basic features of such an environment in four areas. These areas include the following: Strengths, Weaknesses, Opportunities and Threats. The use of this method to describe both current trends in the functioning of such infrastructure in Ukraine and to specify the main obstacles to its development is due to the simplicity of this type of analysis and the clarity of its basic components.

In the process of studying the basic obstacles to the development of the digital economy infrastructure, SWOT analysis is a fairly convenient way to identify such obstacles because:

To identify the problems of digitalisation of business in Ukraine, we will use the SWOT analysis methodology. This method directly allows us to systematise the main features of the development of the digital economy infrastructure and to rank them by content and impact. It is based on the search, identification, and systematisation of the following: Strengths, Weaknesses, Opportunities, and Threats. It is the application of this method that specifies the main obstacles to the development of business digitalisation due to the simplicity of SWOT analysis and the clarity of its basic components. In the process of identifying the main barriers to the development of digital economic infrastructure, SWOT analysis is a very practical way to identify these barriers, since.

Table 2.1 presents information on the weaknesses and strengths of the digital economy infrastructure development, as well as the main opportunities and threats to its further development.

The analysis of the information in Table 1 shows not only the prospects for the development of business digitalisation in Ukraine, but also the existence of certain problems associated with its digitalisation. It is worth noting that the SWOT analysis of the digitalisation of business development in Ukraine shows few strengths. This negative current situation is exacerbated by the extreme complexity caused by the war with the Russian Federation.

However, the country also has and will continue to increase the number of various opportunities that will arise for the development of business entities based on the introduction of digital technologies, and investors interested in investing are investing their capital in the development of promising areas of construction. digital society. It should also be noted that among the threats to the further development of the digital economy infrastructure are generally traditional obstacles to the national economy. Their gradual resolution will also contribute to the development of the national economy and the infrastructure of digitalisation processes.

Table 2.1. SWOT analysis of digitalisation of business development in Ukraine

Strengths	Weaknesses
- a system of training computer specialists in demand on the labour market; - a large number of domestic IT specialists who are potential employees; - legal quality in the field of e-business development; - the ability to freely search for information on the Internet; - saving time and reducing costs; - diversification and acceleration of business - Optimisation, improvement of efficiency and quality of work - Development of additional services	- incomplete development of e-government; - low quality of legislative institutions; - cost of Internet services; -energy dependence; - low qualification of employees; - the degree of state support for the development of the IT sector, especially in the field of small business; - the level of development of the business telecommunications infrastructure; - protection of the rights of consumers of electronic services, network users; - formation of a taxation system in the field of computers; - Low level of intellectual property protection: - Insufficient provision of financial resources for development; - Significant disparities in the development of digital infrastructure by region of the country.
Opportunities	**Threats**
- insufficient level of creative development of the telecommunications sector, which requires new investments; - increasing demand and the need to expand infrastructure due to the growing demand for digital technologies from business entities; - gradual integration of the country's business into the European Union, implementation of European standards and approaches to ICT development; - introduction of fifth generation communications;	- macroeconomic instability; -energy instability - instability and poor quality of the Internet; - an increase in the number of cyberattacks and ineffective cybersecurity systems; - general staff shortage.

Source: compiled by the authors

Therefore, the achievements of the digital economy may be overshadowed by the rather serious risks mentioned above. To mitigate them, it is necessary to identify specific risks of the digital economy in a timely manner and quantify these risks when designing any digital system. However, there are many industries that will have limited access to digitalisation. It is necessary that processes can be standardised and digitised. But when you still have to be creative and improvise, the possibilities will still be limited. This has long been said by various scientists. Artificial intelligence will not surpass human intelligence. Although it can even write small articles and

even compose poetry. But despite all this, it is far from a masterpiece of literary or artistic genius. There are many design programs for architects that help calculate various indicators and dimensions of a building, but so far no one has been able to replace an architect who creates architectural masterpieces. The development of digitalisation, the Internet of Things, and everything else can displace humans from the career of an automator. And then people will have a choice: to develop their creativity, which is necessary for work where computers are powerless, or to degrade, living on the main income from the state. In addition, digitalisation will not replace communication. Perhaps not for everyone and not throughout their lives, but there is a need for communication. Businesses in many industries depend on it. In particular, many women and men go to beauty salons, cafes, and restaurants not only to receive appropriate services, but also to be in a good mood, the main factor of which is pleasant communication with the staff, who, at best, also serve as a psychologist, confessor, doctor, and so on. Digitalisation is powerless here, it is just a tool to convert the menu into an electronic version if necessary, nothing more.

Business digitalisation is a rather evolutionary and organic process: New operating conditions have already been established in the markets. Thus, some business entities have not been able to navigate the innovations, and they will either withdraw from the race, not being up to date, or start a new round of development. Thus, the strongest and most flexible legal entities will always implement new technologies and approaches in the business process. They will encourage others to make innovative changes by their example.

Due to dynamic changes in the environment, businesses must constantly improve their competitive strategy, which will include automated solutions and the use of innovative technologies. Digitalisation is becoming a necessary trend, which, if ignored, will lead to the company's backwardness, loss of potential customers and eventual disappearance from the market. The introduction of digital technologies into business will increase the innovation and creativity of a particular type of activity. In order to find new ways of digitalisation, it is appropriate to follow the areas of innovative development of enterprises, including the digital environment, digital

management, digital culture and digital strategy. In terms of the level of digitalisation of the economy and society as a whole in different countries included in the Global Digital Competitiveness Index, Ukraine is improving, moving up two places from 60th to 58th, driven by talent acquisition, digital/technological skills, e-participation, and company agility. Such minor improvements allow us not only to optimistically forecast the level of innovative development of industrial enterprises through the prism of digitalisation, but also to adjust goals, objectives and strategic guidelines.

Doing business effectively in the digitalised world requires the use of digital technologies in business processes, management, and business models in general, as the ability of enterprises to operate for a long time depends on how well thought out their business models are in terms of creating customer value. Digital technologies and new analytical methods, such as big data, create new opportunities in the functioning and development of BMs. The results of the study deepen the theoretical knowledge of the impact of digital technologies on business models.

The results of the study can be used by senior management and business developers, as a clear definition, examples and tools facilitate the DT of business models. These stages of digital transformation enable companies to take advantage of the potential of digital technologies (e.g. sensors, big data) and rethink their business model. By applying these stages, companies can optimise their current BM and create a clear competitive advantage.

Despite the actual presence of various elements of the information and digital economy in Ukraine, there is, unfortunately, no comprehensive approach to its development on a national scale. In recent years, accelerated economic development has been driven by digital platforms, whose penetration into the social and economic life of mankind is becoming total. However, due to objective reasons, including the war, digitalisation will not be able to penetrate all economic and social spheres equally quickly and deeply. There is a certain unevenness in its spread, which is likely to increase over time.

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MANAGEMENT OF INNOVATION PROCESSES IN THE BUSINESS ENVIRONMENT IN THE CONTEXT OF DIGITALIZATION OF THE ECONOMY

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Citation:
Koval, Ya., Zahorodnia, A. (2023). Management of innovation processes in the business environment in the context of digitalization of the economy. *The development of innovations and financial technology in the digital economy:* monograph. OÜ Scientific Center of Innovative Research. 2023. 230 p. PP. 107-126, https://doi.org/*10.36690/DIFTDE-2023-107-126*

Abstract. *The process of digitalization is characterized by transformation, the introduction of digital technologies to optimize and automate business processes, improve communication with consumers and increase the efficiency of business activities. Today, the introduction of innovations that ensure business digitalization is a catalyst for economic growth and long-term competitive advantage. The rapid and profound effects of the transition to digitalization will only be possible when digitalization becomes the basis of the life of our society, business, and government agencies. In addition, Ukraine's digital development is about creating market incentives, motivations, demand, and shaping the needs for the use of digital technologies, products, and services among Ukrainian industries, spheres of life, business, and society for their efficiency, competitiveness, and national development. There is a need to organize the company's activities taking into account the peculiarities of the transition to new principles of the digital economy, forecasting possible related problems, as well as developing solutions and proposals to minimize the negative consequences and enhance the main result of the company's activities. A system of effective management of available resources and business processes of an enterprise based on innovative technologies and methods of business process optimization, which are becoming an important management tool through continuous process improvement and optimization, can provide significant competitive advantages. Thus, it is advisable to analyze the system of managing innovation processes in the business environment in the context of the digitalization of the economy. The purpose of the study was to study the features of innovative process management in the business environment in the conditions of digitalization of the economy. The results of the study show that a favorable innovation environment should be formed proportionally. The disproportion of the innovation environment towards content, technology, or competencies leads to unfavorable conditions for innovation, as well as the emergence of an "IT trap" on the path of a business entity to the digital economy. In view of the above, it is worth noting that the digitalization of society is expanding the range of subjects of innovation activity, including Internet users. The innovative potential of individuals is currently underestimated, and it is enormous.*

Keywords: *digitalization, innovation processes, business environment, digital transformations, management.*

Digitalization in Ukraine is still happening at a much slower pace than in developed countries. Nevertheless, today's rapidly changing business environment requires managers to use the latest digital technologies and, accordingly, new management approaches. Today, the introduction of innovations in business practices that ensure its digitalization is a catalyst for economic growth and long-term competitive advantage.

The approved goals and directions of the Strategy for the Development of the Information Society of Ukraine, approved by the Cabinet of Ministers of Ukraine on May 15, 2013, No. 386-p. The basis for the development and implementation of the Strategy is the Constitution of Ukraine and the Law of Ukraine "On the Basic Principles of the Development of the Information Society in Ukraine for 2007-2015", other regulatory acts, according to which the state creates conditions for the development of the information society in Ukraine, indicate that IT infrastructure and information resources should facilitate the creation of innovations. Information technologies and information resources alone create new opportunities for creating innovations, but are not sufficient for organizing innovation activities in the context of digitalization.

Innovation activity can be represented as a linear process that involves the sequential passage of several stages. Most researchers define basic research as the initial stage of innovation activity. However, research results show that there is no well-established mechanism for transferring the obtained research results to innovation activities.

The processes of scientific research and innovation activities have important differences, the main ones being the goals of these processes. The purpose of scientific research is to obtain new scientific knowledge, while innovation is aimed at developing an innovation that meets market demand and profitability requirements. The results of scientific research contribute to solving a scientific problem. Often, a scientific contribution may consist in finding approaches and methods that are not applicable to solving a scientific problem, but this contribution significantly shortens the path to its solution in further research.

Scientific research is usually funded in the form of grants and projects that provide for reimbursement of costs based on research results. Financing of innovation is perceived as an investment in the future achievement of economic effects by business entities, gaining competitive advantages, increasing market share, reducing the cost of customer service, etc.

Fundamental and applied research should be distinguished as a special type of activity carried out by research organizations that are involved in the generation of all types of resources for innovation. Research organizations create information resources, improve or develop technologies, acquire new knowledge and competencies in performing operations, solving economic problems, etc. A business entity (enterprise) receives information about scientific research and its results through access to information resources. It is determined that science and innovative competitiveness have a great influence on each other.

Business entities, as a rule, do not conduct scientific research, but are directly involved in the creation of these innovations, which will be new, popular in the market and will bring profit. The impetus for creating an innovation is the search for an idea as a result of creativity. Scientists note that under the influence of external factors, the innovation process is formed, which includes: the formation of an idea (or concept), the development of an innovation (prototype) and innovation.

One of the researchers of creative thinking, Edward de Bono [1], notes that the need for information and its analysis are the constituent elements of creative thinking.

In the XX century, domestic and foreign scholars began to consider creative activity as a system that covers almost all business processes and requires appropriate methods and technologies. Approaches to the organization of creative activity have emerged, the most popular of which are the Inventive Problem Solving Theory (IPT) and lateral thinking. Inventive Problem Solving Theory (IPT) is a science that studies the objective laws of system development and develops a methodology for solving problems, i.e., rules, techniques, methods, laws that can be used to invent and find solutions to problems.

In foreign and domestic practice, the design thinking approach to organizing creative activity and searching for innovative ideas is becoming popular. Methods of searching for an idea are in many ways similar to methods of searching for new knowledge.

For a business entity, the starting point of the innovation process is the search for an idea. The scheme of the innovation process is shown in Fig. 2.1. Depending on the type of economic activity of a business entity and the innovation it creates, the innovation process may be supplemented by various stages. An innovation process aimed at bringing an innovation to the market may include the stage of acquiring a ready-made innovation.

Innovations of various kinds and types may result from innovation activities. Innovations in the economy are manifested mainly in the form of reducing the cost of goods or in the form of new qualities of goods that are preferred by consumers. In order to win in the competition, innovation is one of the most important means.

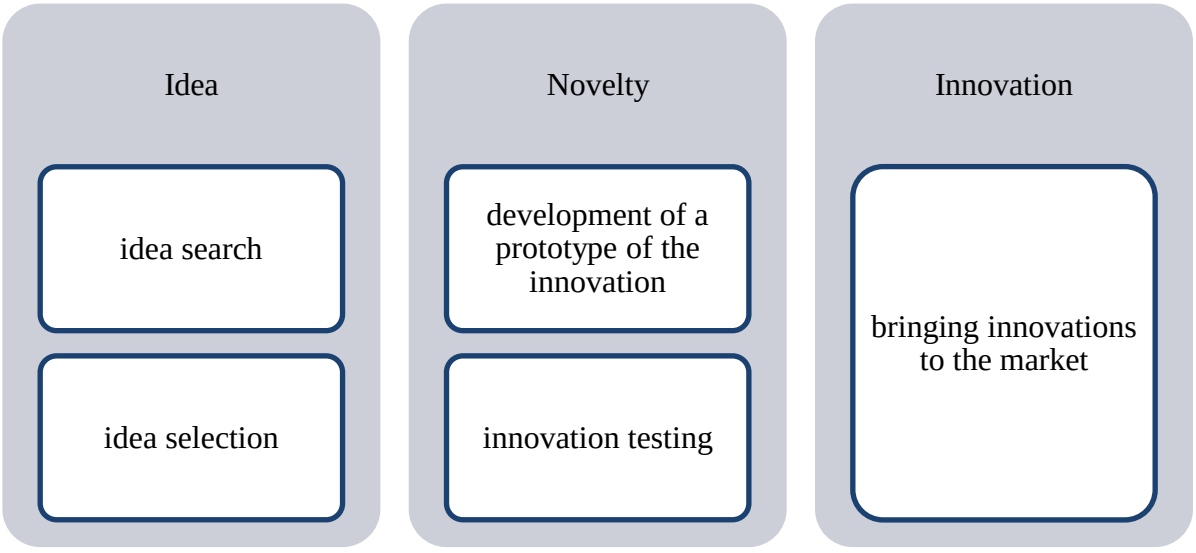

Figure 2.1. Diagram of the innovation creation process

Source: compiled by the authors

What unites innovation processes and the stages of their implementation is that they are creative. The first step in creating an innovation or acquiring it is to find an idea. At the first stage, the problem is formulated, possible solutions are identified,

solutions are analyzed and evaluated according to the selected criteria, and the best option is chosen. Creativity is of great importance in finding a social problem or economic need that can be addressed by an innovation. It is scientific and technical creativity that allows turning an idea into an innovation, and an innovation into an innovation.

Also, the organization of production and bringing an innovation to the market requires a creative approach.

Specialists who create innovations should develop creative thinking. F. Webster [2] notes that despite significant differences in views on the form and content of the information society, almost all scientists agree that human creativity, which includes analytical processing of information and creation of new knowledge, is becoming the most popular and valuable.

In the context of the spread of smart IT and the penetration of automation into many processes, professionals must first of all be ready to creatively search for solutions, ideas and future prospects.

Internal resources of a business entity are not enough to create effective innovations. Generating and accumulating types of innovation resources is an expensive and time-consuming process. Internal information resources contain information about the entity's developments, products, services and processes. Competencies include the amount of knowledge and experience accumulated by the entity in solving creative tasks [3].

Internal resources constitute the innovative potential of a business entity, which allows it to use the most important resources in its innovative activities. Experts in the field of innovation management say that "in-house research and development is an excellent means of increasing the ability to perceive new things". Businesses need experience in creating innovations to acquire and disseminate effective innovations. Thus, the innovation environment should provide the opportunity to act as both suppliers and consumers of innovations.

External resources for a business entity serve as a means of access to global experience and achievements (Fig. 2.2). The theoretical provisions of the concept of

innovation environment are that the most important resources of innovation activities are accumulated in the external environment as a result of the activities of many business entities. The most important resources include content, technologies and competencies.

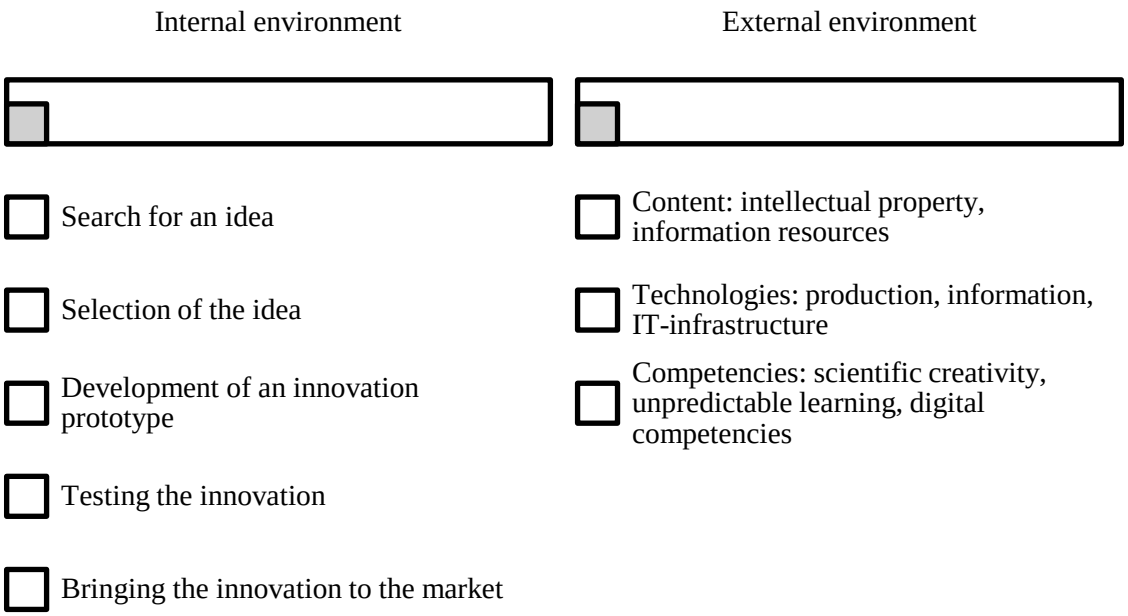

Figure 2.2. Resource support of the stages of the innovation process

Source: compiled by the authors

The resources necessary for innovation are contained in the environment in which the business entity operates. It is customary to distinguish between internal and external environments in relation to an entity. The external environment is determined by various factors, including market, political, social, cultural, geopolitical, etc. In the scientific literature, the concepts of "environment" and "space" can be found in the same sense. Often, the concept of "space" is related to the regional economy, where the geographical factor is decisive. There are also various definitions of the external environment in the scientific literature, including environmental, market, educational, institutional, socio-cultural and political environments [4].

The variety of approaches to defining and systematizing the environment of business entities indicates the complexity of this concept.

Financial factors are often put at the heart of the potential for innovative development of the domestic economy. A number of studies reveal a lack of financial resources for successful innovation activities of domestic enterprises. Researchers emphasize that manufacturing enterprises need financial and investment mechanisms to create innovations to a greater extent, while the factors of availability of IT, information resources and competencies (qualified personnel) fade into the background. However, the study of quantitative indicators of access to IT, information resources and competencies for innovative activities of enterprises demonstrates the shortage of these resources for domestic enterprises. Financial support is undoubtedly important for any activity, as well as the ability to acquire the necessary resources for its implementation.

The need to introduce the concept of innovation environment is due to the specifics of innovation activity and its high importance for economic growth. Despite the fact that the concept of "innovation environment" is popular, there is no common understanding among domestic and foreign scholars of what to include in this Concept [5].

Let us consider approaches to defining the content of the innovation environment. In terms of content, the innovation environment is a set of innovations that create new opportunities for the development of a particular area.

The concept of "innovation environment" appeared in the 1980s as a means of analyzing the systemic conditions for organizing the innovative activities of economic entities in order to create new production and develop new markets. One of the first scholars to define this concept was Manuel Castells, who viewed it "as a specific set of production and management relations based on social organization, which generally shares a work culture and instrumental goals aimed at generating new knowledge, new processes and new products." This definition is based on a systemic principle, where the researcher considers the innovation environment as a set of different systems that ensure the creation of innovative products, but only in the process of organizing and managing production [6].

There are various definitions of the innovation environment in the scientific literature. Let us consider some of them:

- innovation environment (IE) - a set of certain components of the socio-economic, organizational, legal and political environment that ensure or hinder the development of innovation activities to realize and increase innovation potential. It is divided into external and internal environment. This concept does not clearly define the specifics of the innovation environment, but rather considers the interconnection of different environments;

- innovation environment - a set of mechanisms, tools, processes, infrastructure elements and human capital that support innovation activities. In this context, the mechanisms and tools that support innovation are defined [7].

All of these definitions reflect the subjective views of researchers on defining the boundaries within which the innovation system will be created. It should be noted that there is no single definition in the regulatory framework yet.

The innovation environment should be understood as a set of systems that are the fundamental core that forms innovation activity, based on the classical theory of innovation by J. Schumpeter.

There are several approaches to considering the essence and content of the innovation environment:

- social approach, in which the innovation environment is understood as "...a set of legal, material, financial, economic, political, spiritual conditions of existence, the formation of interacting individuals, social groups, institutions, cultures that ensure the development of innovations and their further transformation into innovations. In other words, an innovation environment is a social space organized in a certain way...";

- activity-based approach, in which the innovation environment is understood as "...a certain socio-economic, organizational, legal and political environment that has developed and provides (stimulates) or inhibits the development of innovation activities..."

- the environment approach itself. This approach considers the innovation environment either as "...a combination of the internal and external environment of the participant of the innovation process..." or "...as the environment of the participant of the innovation process, which has an indirect or direct impact on the conditions of innovation activity and its result..." or "...the environment that constitutes the external environment of any participant of the innovation process, which has an indirect or direct impact on the conditions of innovation activity and its result...".

It should be noted that in the latter aspect (the environmental approach), the innovation environment is also considered not only as an environment, but also as "...socio-economic, legal environment...", in which "...transfer and use of knowledge, ...commercialization of innovations..." takes place.

Some studies present the innovation environment as a set of academic, educational, professional, technological, economic, entrepreneurial, expert and other environments.

However, such broad definitions do not allow for the development of correct tools for assessing the state of the innovation environment and managing its formation.

In the works of some scholars, great attention is paid to technological factors of the innovation environment, such as Internet penetration and development of technological infrastructure and access to it, provision of the economy with highly productive jobs, as well as social aspects. These approaches are aimed at studying the internal environment of a business entity for conducting innovation activities, namely the intensity of IT use, the impact of IT and the Internet on the state of the social and economic environment [8].

The methodologies of international organizations, on the contrary, emphasize the state of the macro environment of innovation. The World Bank identifies four pillars of the knowledge economy in its measurement of the knowledge economy: training, adaptation of innovations and technologies (use of innovations and technologies), information infrastructure, and a favorable economic and institutional regime. Investments in these pillars of the knowledge economy should lead to

increased productivity and knowledge-based economic growth. The World Bank's methodology is designed to help countries identify the challenges that need to be addressed and the opportunities they can exploit in the knowledge economy. Through its assessments and research, the World Bank draws the attention of policy makers and entrepreneurs to issues that require government support and future investments necessary for the country's transition to a knowledge economy. The peculiarity of the World Bank's methodology is that it includes a large number of expert assessments, which are subjective indicators.

Some leading researchers insist on the allocation of regional classification features when considering the innovation environment. This is the place where services are created and consumed in the electronic environment, the territorial factor is not critical. Despite the fact that domestic software developers are separated from American ones by an ocean, they are heavily influenced by american IT companies [9].

Many years of research and accumulated empirical data indicate that innovations are created taking into account the accumulated global experience and knowledge in almost all regions and sectors of the economy. The globalization trend in information support of innovation activities leads to the fact that information about innovations or new knowledge is instantly spread around the world, thereby removing any spatial barriers to access to them. It should be noted that globalization does not solve the problem of overcoming the digital divide in economic development by individual regions.

The example of high-tech corporations Google shows that these companies go beyond the IT industry and the World Wide Web. They find applications for their developments in various economic spheres, including education, catering, retail, etc., which they had not considered for economic activity.

All enterprises operate in an environment that, thanks to the Internet, globalization and convergence trends, is becoming common to them. Differences arise in the subjects themselves in terms of using the capabilities of this environment to access the resources of innovation and create innovations.

The innovation environment can be understood as the environment in which business entities interact with innovation resources and other entities (customers, partners, suppliers, etc.). In the previous phases of socio-economic development, this interaction took place within the internal environment, and in these conditions it includes external resources and external actors. Thus, the environment of innovation activity becomes external.

The innovation environment performs a number of important new functions:

- providing access to external (for organizations) resources of innovation activity;

- involvement of external actors in the organization's innovation process, for example, through crowdsourcing mechanisms or living laboratories

- integration of innovation resources into the ecosystem, which allows organizations to use resources taking into account their interconnections.

The environment defines the basic conditions, the change of which leads to the support of certain activities or the creation of barriers to their implementation [10].

The concept of innovation environment is included in such concepts as the knowledge society and the digital economy. But at the same time, the concept of "innovation environment" is generic for a number of other concepts (Fig. 2.3).

Let's consider the concepts included in the ontology of the concept of creating a favorable innovation environment for the digital economy.

A knowledge society is a society whose development is ensured by expanding the employment of citizens in the field of knowledge creation, dissemination and use, where the IT infrastructure guarantees all stakeholders access to IT and information resources.

An information society is a society in which information and the level of its use and accessibility have a fundamental impact on the economic and socio-cultural conditions of citizens' lives and the economic activity of enterprises.

The digital economy - is an economic activity characterized by the growth of economic efficiency through the use of information resources and the totality of IT.

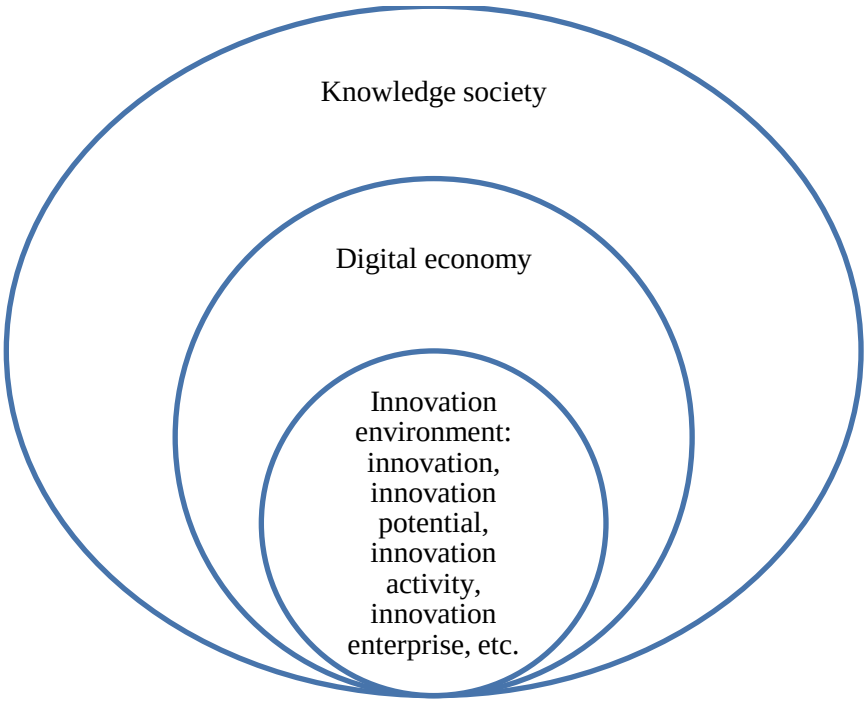

Figure 2.3. Relation of the concepts of innovation environment to other concepts

Source: compiled by the authors

The innovation environment includes the following concepts:

Innovation - is the final result of innovation activity, which is embodied in the form of a new or improved product introduced to the market, a new or improved technological process used in practice, or a new approach to social services.

The innovation potential is the ability of a business entity to create innovations, which is expressed in the provision of personnel, intangible assets, information resources, enterprise development strategy and innovation policy [11].

Innovative entrepreneurship - is a special innovative process of creating something new, a business process based on a constant search for opportunities and a focus on innovation.

Innovative development - is a process of qualitative transformation of technical and technological factors and organizational and economic conditions of production and economic activity of socio-economic systems based on the creation and implementation of innovations.

Innovative activity - is a type of activity related to the transformation of ideas into technologically new or improved goods or services introduced in the market, into

new or improved technological processes or methods of production (transfer) of services used in practical activities.

The innovation process - is a set of actions to transform knowledge or ideas into innovations, usually including the stages of searching for an idea, developing an innovation and bringing an innovation to the market.

In the context of the transition to the digital economy, the innovation activity of business entities directly depends on the state of the innovation environment.

The innovation environment of business entities largely depends on external factors and consists of the conditions of access to external resources for innovation. If access to resources is not complicated, it will be a favorable innovation environment, and if access to resources is limited and/or complicated, the innovation environment will be unfavorable [12].

The concept of forming the innovation environment of the digital economy ensures the development of this environment in such a way that business entities have access to the resources of innovation in the context of digitalization of society.

The study has shown that the most important information resources for innovation in the development of the digital economy are divided into three types: content, technology and competencies. Access to these resources has a great impact on the innovation activity of business entities in developed and transition economies.

In the process of innovation activity, a business entity interacts with the innovation environment in an individual way (Fig. 2.4).

An entity uses an individualized set of resources from the external environment through mechanisms such as contracts, licenses, or government support measures. The composition of the innovation environment resources used by an entity depends on the type of activity that is core to the entity. Innovation activity will depend on the internal factors of the entity, while external factors will serve to limit its potential. The environment determines the basic conditions of a particular activity. Changes in conditions lead or may lead to the support of certain activities, as well as the creation of barriers to their implementation.

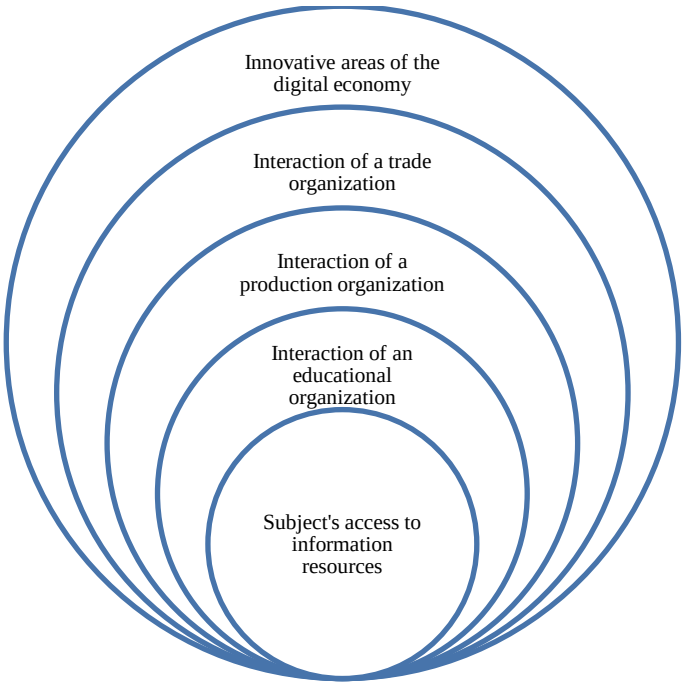

Figure 2.4. Interactions of business entities in the innovation environment

Source: compiled by the authors

The concept of forming an innovation environment is based on the development of information resources of innovation activities: content, technologies and competence. In general, the transition from one stage of IT application to the next leads to the expansion of the innovation environment, which makes new types of innovation resources available to business entities for use.

The development of one type of information resource for innovation should be supported by the proportional development of other types. In order for a business entity to obtain valuable information or new knowledge from an increased amount of content, it needs access to appropriate computing power (technologies) and competencies. At the same time, the emergence of new technologies should be accompanied by new content and competencies [13].

The development and spread of IT creates opportunities to engage citizens, consumers of goods or services, clients, partners, and public authorities in innovative activities. Expanding the range of innovation actors allows for the use of new methods of collecting ideas, such as crowdsourcing, testing an innovation or

prototype, and bringing an innovation to market through new competencies and information resources.

Changes in the content, technologies, and competencies of the IT economy are presented in Table 2.2.

Table 2.2. The most important information types of resources of innovation activity at the stages of using IT economy

Stage	Content	Technologies	Competencies
Automation	Structured data	Automated processing of structured data	Collection, storage and processing of structured data
Informatization	Information resources, including structured, unstructured, and unstructured data	Corporate information systems, decision support systems	Search, evaluation and processing of information resources
Digitalization	A digital data resource that is updated in real time	Large data, neurotechnologies and artificial intelligence, distributed ledger systems, etc.	A wealth of knowledge, skills and abilities to apply digitalization achievements in economic activities

Source: compiled by the authors

The development and growth of each type of innovation resource is the result of the activities of many entities that act independently of each other, and, on the other hand, combine their computing devices and communication lines into a common IT infrastructure that allows them to collect and process digital data together. Accordingly, the innovation environment can be measured by the sum of all the resources available to the subjects of their activities [14].

In accordance with the developed system of indicators of the state of the innovation environment of the digital economy, we will set targets and thresholds for monitoring the process of its formation. Given that the development of the digital economy is a global trend, and as a result of digitalization, globalization factors increase their impact on the effectiveness of innovation, the values of indicators of the state of the innovation environment should be set depending on the development of global information resources.

The threshold value of the indicator of formation of the innovation environment of the digital economy should be set only at the level of the world average. In this case, the development of the digital economy and the realization of its opportunities in Ukraine will go hand in hand with the development of the world economy.

In order to obtain advanced effects from the development of the digital economy, Ukraine's innovation environment must develop at a pace that is faster than the global average. High rates of development of the innovation environment of the digital economy are demonstrated by: China, the United States, South Korea, Japan, Germany, and the United Kingdom.

Modern official business and scientific literature introduces concepts with the adjective "digital" to emphasize the change in the stages of IT use from informatization to digitalization. Thus, the concepts of "digital content", "digital technologies" and "digital competencies" have become established. Let's consider the content of the most important types of innovation resources, access to which is necessary in the innovation environment of the digital economy [15].

Digital content as a type of innovation resource includes information resources stored in digital form. Starting from the automation stage, there has been an accumulation of arrays of structured data in digital form, which is almost the entire modern information resource. Thanks to the spread of IT, every business entity is able to use digital data in its innovation activities. A business entity can organize the collection and processing of digital data on its own or purchase these services from data providers, such as digital platforms.

At the stage of informatization, knowledge was of great value for innovation activities as the most meaningful category of information that can be used to solve problems, including the development of innovations. At the same time, the main task that has grown within the framework of information support for innovation activities is to identify the source of new knowledge, systematize it and organize access to it.

In the context of digitalization, the amount of data that can be processed using IT to find the solution to an information problem is of particular value. It should also

be noted that the amount of accumulated digital data increased more than 2,000 times between 2010 and 2021 [16].

Thus, the type of innovation resource - content - includes the entire array of data accumulated by society in digital form.

In the context of the concept, digital technologies are expressed as a set of IT that ensures the accumulation and processing of digital data. Digital technologies include, in addition to new IT, already widely known ones (artificial intelligence, 3D printer, etc.), for which the modern IT infrastructure, due to the depreciation of the technologies themselves, and the accumulation of the necessary data volumes, has made it possible to find new ways to apply them in the economy. It should be noted that back in 1990, the concepts of computer, electronic and digital technologies were perceived as identical. The popularity of certain terms varied depending on economic sectors and even continents. For example, while in Europe the most commonly used terms were "electronic library", "electronic service", etc., which by definition were electronic, in North America the term "digital" was more common and, accordingly, "digital library", "digital service", etc.

For the purposes of state policy in the digital economy, the concept of "end-to-end technologies" is distinguished. "Cross-cutting technologies are key scientific and technical areas that have the greatest impact on the development of new markets. They are organized into groups such as big data, artificial intelligence, distributed ledger systems, quantum technologies, new and portable energy sources, and others."

The composition of digital technologies can vary significantly across different sectors of the economy. For example, the research company Gartner annually publishes reports on technology cycles in various industries (education, healthcare, electricity, financial services, government, manufacturing, retail, new technologies and telecommunications) and types of economic activity (audit and risk, communications, customer service and support, finance, human resources, information technology, innovation and strategy, marketing, trade, supply chain) [17].

Digital competencies imply the ability of specialists to create innovations using digital content and technologies that increase the efficiency of economic activity. At the same time, the composition of digital competencies will vary significantly depending on the industry in which the business entity operates and the subject area in which each particular specialist works. Possession of knowledge and competencies by the relevant specialist in the subject area is the basis for the formation of digital competencies.

In order to use the achievements of the digitalization of society in innovative activities, special competencies in working with both technologies and data are required. The concept of computer literacy or information competence has been replaced by the concept of digital competence [18].

Leading scholars distinguish several types of digital skills, including general, professional, complementary, and skills in using digital economy services. The regular change of names in the designation of the necessary IT training and content reflects the fact that these requirements are constantly evolving and becoming more complex.

The results of the study show that a favorable innovation environment should be formed proportionally. The disproportion of the innovation environment towards content, technology, or competencies leads to unfavorable conditions for innovation, as well as the emergence of an "IT trap" on the path of a business entity to the digital economy.

Business entities of the above-mentioned types of economic activity are the first to move to the digital economy and create the necessary socio-economic, information and technological conditions for access to the achievements of the digitalization of society for entities of other types of economic activity.

The innovation environment is formed by many business entities, objects and relations between them, which have a direct or indirect impact on each other's economic activities. A number of scholars identify the following subjects of the innovation environment:

1. Financial institutions that provide investment support for innovative activities of business entities are subjects of innovative activities.

2. Scientific research institutes (R&D) as a source of scientific knowledge in the field of basic science and applied research are included in the list of innovative entities. It should be noted that R&D institutes are an important element of the innovation system that generates all types of innovation resources.

3. Educational institutions that provide training for innovative activities and are subjects of innovative activities. In the context of the digitalization of society, new business entities are emerging whose activities are carried out exclusively in the electronic environment of the Internet using digital data and computing devices. As a rule, these resources of innovative activity are not owned by the business entity. In the innovation environment, a new type of entity should be identified - the owners of digital data and computing power.

In view of the above, it is worth noting that the digitalization of society is expanding the range of subjects of innovation activity, including Internet users. The innovative potential of individuals is currently underestimated, and it is enormous.

Consumers of goods and services are a source of ideas for the innovation process. Business entities are certainly interested in including consumers in their innovation environment, thereby allowing them to be involved in the development and testing of their goods and services. The practice of consumers improving goods is quite common.

Economic theory has established that property relations through production (economic activity) form the basis of socio-economic relations. In the case of digitalization of society, the ownership of the most important resources of innovation is rapidly transforming.

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ORGANIZATION AND IMPLEMENTATION OF ELECTRONIC DOCUMENT MANAGEMENT AT ENTERPRISES: THE PATH TO DIGITIZATION OF THE INFORMATION SPACE OF THE ACCOUNTING AND TAXATION

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Citation:
Bradul, A., Burkova, L., Shepeliuk, V. (2023). Organization and implementation of electronic document management at enterprises: the path to digitization of the information space of the accounting and taxation. *The development of innovations and financial technology in the digital economy:* monograph. OÜ Scientific Center of Innovative Research. 2023. 230 p. PP. 127-146, https://doi.org/*10.36690/DIFTDE-2023*-127-146

Abstract. *The management of information support of the enterprise is closely linked to both the availability of information resources and with the possibility of introducing information innovations in ordering the documentation and information flows of the enterprise. With the help of information technologies, companies try to automate their work at the expense of the latest electronic technologies. In society, documents are considered the main carriers of information. The evolution of electronic document management systems, starting with simple documents, continuing systems on electronic copies of paper originals and reaching the systems in which the original document should be electronic, and a copy of such electronic document may exist on paper. The relevance of this topic is due to the fact that one of the most complex areas for the introduction of automated information systems in Ukraine is document management. The main problems of transition of enterprises, including corporations for electronic document circulation are the reluctance of employees to work with documents according to the usual scheme. And this is a significant problem, because document flow is a system that provides work with documents that come from the outside and prepare within the company, first of all registered, transferred to employees of the organization, help to control the performance of certain work, conduct reference work. The introduction of electronic document management technology at enterprises is an effective tool for managing information support for enterprises, which is a key factor in successful and successful business and provides an opportunity to increase the competitive advantages of enterprises in strict market conditions. Document management is replaced by electronic systems today in the information technology development era.. The recearch describes the essence of document management and the importance of its rationalization in the creation of a transparent information space and to form optimal conditions for working with accounting documents. The purpose of the article is to investigate the processes of organization and procedure for conducting electronic document circulation, legal status and relations with the use of electronic digital signature and to determine the benefits of the system of organization of electronic document circulation using electronic documents. To solve these tasks, a set of general scientific and special research methods, in particular: generalization and comparison - to establish the similarity and differences of the results of research of other authors on understanding of the nature of the categories "document, document management"; graphic - to present information presentation, etc. The results of the study - providing comparative characteristics of the stages of electronic and paper document management, and the algorithm for the introduction of electronic document management at the enterprise has been developed.*

Keywords: *accounting, information, document, primary documents, electronic document, electronic document flow, electronic signature.*

The present stage for the effective management of the enterprise and its structural units in the conditions when the situation is constantly changing and the competition of producers is developing, timely and reliable information is required. Information is such data that enables the specific user to increase their degree of awareness. [1, p.192]. From the point of view of the theory of information processes, information is considered as a characteristic of a system opposite in nature to the entropy of the system, that is, a measure of ordering of the system [1, p.192]. In accordance with this, the information must meet certain requirements. Such information provides accounting as the main means of accumulating information that is necessary to regulate the production process, as well as the necessary element of the process of development and implementation of the management decision.

Denysenko MP, Kolos IV, consider “the maximum satisfaction of information needs of all participants in production and economic activity is a criterion for effective management of modern enterprises. Information support of the enterprise management provides for the organization of purposeful arrays of information and information flows, which includes collection, storage, information in order to analyze the results obtained for preparation, justification and adoption of management decisions ”[2, p. 20].

Article 1 of the Law of Ukraine "On Information" provides the concept of category "information" - documented or publicly announced information about events and phenomena occurring in society, the state and the environment [3]. The definition of the category "information" contains . 1 tbsp. 200 of the Civil Code of Ukraine defines "information as documented or publicly announced information about events and phenomena that have or occur in society, the state and the environment" [4]. The basic act of civil law defines information similarly to the Law "On Information, but still includes events and phenomena that occur or occur, leaving, however, information about the future beyond its attention.

Information (from Latin Informatio - explanation) - information that transmit oral, written and other ways through conditional signals and technical means. [5]

n the domestic scientific literature on certain problems of information law, the authors characterize information as a set of interrelated processes aimed at meeting the information needs of citizens and society [6].

Therefore, information in the general sense is a system of information about certain processes, events, situations, etc. Information is the object of fixation, storage, transmission and transformation for use in any area of activity.

Accounting is a system of generating information resources about the economic activity of the enterprise, the information system must ensure the quality of information, to increase its value for users.

The most important, from a practical point of view, the properties of information are value, reliability and relevance.

The value of information from the point of view of accounting, ensuring the timeliness of achieving the goal set before users of information.

Ukrainian scientist IV Zhigley believes that “modern conventional accounting is based on a functional positive paradigm - a utility paradigm for decision -making, which is more adjusted to reflect social reality and continues to motivate behavior in the direction of meeting the needs of users through fundamental accounting concepts that should take into account globalization processes which, in turn, cause changes in the social status of people and create the need to consider social development on global scale. In the context of the development of the accounting system, globalization is considered narrow as a process of establishing links in the world economy, first of all, through the spread of enterprises outside one country »[7, p. 176–177].

The accuracy of the information obtained is the objective reality of the outside world, the unmistakability and truth of data, as well as the adequacy in the processing and transmission of data in the information system.

Grytsyshen DO It notes that “accounting information today becomes not only economically significant, but also environmentally and socially significant. This is due to the fact that the motives of a "person as an economic agent", first of all, are determined by economic needs that can have both social and environmental

consequences for society. The increase in the importance of accounting information makes it possible to speak about the modification of its tasks in ensuring the provisions of sustainable development of socio-economic systems of different levels ”[8, p. 197].

Economic information is a management tool and at the same time belongs to its elements, it should be considered as one of the varieties of management information, which provides solving the problems of organizational and economic management of the national economy. Therefore, economic information is one of the most massive varieties of information that reflects the processes of production, distribution of exchange and consumption of material goods and services [6].

The varieties of economic information are accounting information. Accounting and analytical information is the basis for management decisions. Features of accounting information depend:

- from the types of accounting (operational, accounting, statistical);
- forms of accounting (tabular-automated, dialog, non-paper);
- from the sources and methods of formation of variable and conditional information and the algorithm of their machine processing.

The credentials reflect the actual state of production and economic activity of the enterprise and is an information model of production. In addition to displaying the true state of the object, a retrospective function is entrusted to accounting information, which requires long -term storage of this information (in the form of accounting forms). The quality of accounting information depends on the used methodology of its perception, systematization and generalization, as well as on the specific features of accounting problems (Fig. 2.5).

The monograph devoted to the integrated accounting system defines "The main task of accounting - providing information for the implementation of the management process in order to achieve the goals defined by the enterprise, both operational and strategic nature, which are focused on maximizing the cost of the enterprise and elimination of asymmetry of accounting" [9].

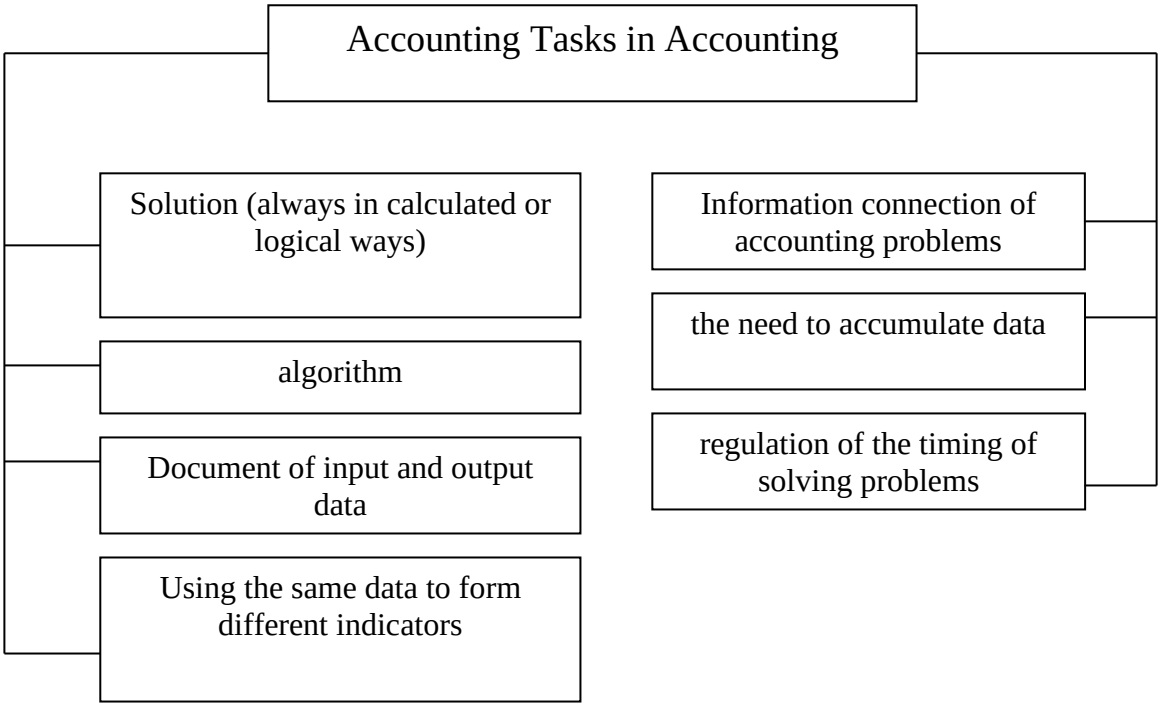

Figure 2.5. Accounting problems of information in the process of enterprise activity [6]

Source: compiled by the authors

The final data is the result of solving accounting problems on finding the summary-summary values according to the established grouping features, for which arithmetic and logical operations, operations of sorting information are implemented.

Today, accounting information is capable of ensuring the dynamic development of the enterprise, but it is closely interconnected with economic systems of different levels, social systems of society and the environment. It can lead to his bankruptcy, but as a result of the economic crisis not only of the state but global economy. Thus, today it is worth talking about the task of the accounting system - information support of interested users and its derivatives, namely: the tasks of accounting information.

The basis of accounting information is a document. The purpose of the document is to record different information in writing for different events.

According to Art. 27 para. 1 of the Law of Ukraine "On Information" "A document is a material form of obtaining, storage, use and dissemination of information by fixing it on paper, magnetic, film, video, film or other carrier" [3].

In their accounting textbook, the collective of domestic authors - F. Butynets, O. Voynalovich and I. Tomashevskaya define the document as "a material object containing information, issued in a certain manner and has legal force" [10, c. 191].

In the Great Modern Interpretative Dictionary of the Ukrainian Language (edited by V. Busel), the document is interpreted as "a business paper certifying a certain legal fact, confirms the right to something, is proof of anything" [11, p. 314].

According to Sopko VV, Zavgorodniy VP, “The main type of accounting media at the stage of primary accounting is a document that is evidence of business transactions. The accounting documents, these authors set the following requirements: availability of mandatory special details, ensuring control over economic facts, production of reporting data, convenience of processing, clarity, compactness, etc.” [12].

According to the definition given in the dictionary of the accountant and auditor, ed. Ya. Kovatorev, "Document" is a written testimony of the economic operation, which gives the legal force of accounting data. The word "document" comes from Latin, which means testimony, evidence, confirmation for their conduct” [13, p. 58].

The main carrier of accounting information in accounting is the primary documents that contain data on business transactions that have been conducted, as well as on the instructions of the management on their implementation.

In the Economic Encyclopedia, primary documentation is defined as "a set of accounting documents that make up to obtain data on economic phenomena at the time of their implementation, and if impossible - immediately after their completion - the initial stage of accounting (fixes these phenomena for the first time" [14, p. 708] .

Ukrainian scientist V. Paliy notes that "the primary documentation confirms the accuracy of data on the facts of economic activity and, if necessary, proof of operations performed in civil and legal persons" [15, p. 19].

In the terminological dictionary of accounting and audit, ed. A. Zavgorodny, G. Vozniuk and G. Partin The concept of "primary document" is defined as a document containing information about the economic operation and confirms its implementation [16, p. 182].

F. Butinets provides the following definition of an accounting document: "This is a written evidence of actual implementation of business transactions or a written order for the right of its implementation" [10, p. 227].

Thus, the primary document is the foundation on the basis of which accounting is carried out.

The table shows the definition of the primary document in accordance with the Law of Ukraine "On Accounting and Financial Reporting in Ukraine" [17]. and "Regulations on documenting records in accounting" [18].

Table 2.3. Definition of the concept of "primary document" in the legislative acts of Ukraine

Article 1 of the Law on Accounting	Regulations on documenting records in accounting
The primary document is a document that contains information about an economic transaction (an action or event that causes changes in the structure of assets and liabilities, equity of the enterprise).	Primary documents are documents created in written or electronic form that contain information about business transactions

Source: compiled by the authors

Therefore, according to legislative acts, the basis for accounting of business transactions is primary documents. Business operations are reflected in accounting by the method of their continuous and continuous documentation. Records in the accounting registers are made on the basis of primary documents created in accordance with the requirements of clause 1.2. Regulation No. 88 [18]. Thus, the purpose of the primary documents is to record the facts of an economic operation.

The Tax Code of Ukraine clause 44.1 is recorded that “for taxpayers, taxpayers are obliged to keep records of income, expenses and other indicators related to determining the objects of taxation and/or tax liabilities, on the basis of primary documents, accounting registers, financial statements, other documents related to the calculation and payment of taxes and fees, which are provided by law ”[19].

Primary documents for granting them legal force and evidence under the Law of Ukraine "On Accounting and Financial Reporting in Ukraine" [17] must have the following mandatory details: the name of the enterprise, institutions on which the

document is drawn up, the name of the document (forms), Code of form, date and place of drawing up, content of an economic operation and its meters (in natural and value), positions of persons responsible for permission to carry out an economic operation and draw up a primary document, the names of persons who gave permission to carry out an economic operation, and direct direct performers of the operation, their personal signatures [17].

Each party (enterprise) that participated in the conduct of an economic transaction must be obtained (used) for records in accounting registers primary documents, information in which information is identical to the content, volume and cost of the economic transaction.

For example, primary documents include documents such as the invoice, the freight invoice, the act of work performed, a profit and expenditure cash order, and others.

Primary documents under Regulation No. 88 [18] are "documents created in written or electronic form, which contain information about business transactions may be compiled electronically or on paper" "it should and contains all the necessary details, has the same legal force as a paper -form document and must be signed by an electronic signature (EP) of the authorized person.

The Law of Ukraine "On Electronic Documents and Electronic Document Management" provides the following definition "An electronic document is a document that is recorded in the form of electronic data, including mandatory document details [20].

An electronic document (ED) is a document created by computer information processing, signed by an electronic digital signature (EDS) and stored on a machine medium in the form of a file of the appropriate format [21]. The composition and procedure of placement of mandatory details of electronic documents is determined by law. According to domestic legislation, all electronic documents with mandatory details and electronic digital signature are considered originals, regardless of the time of creation.

The characteristics of the electronic document are shown in Fig. 2.6.

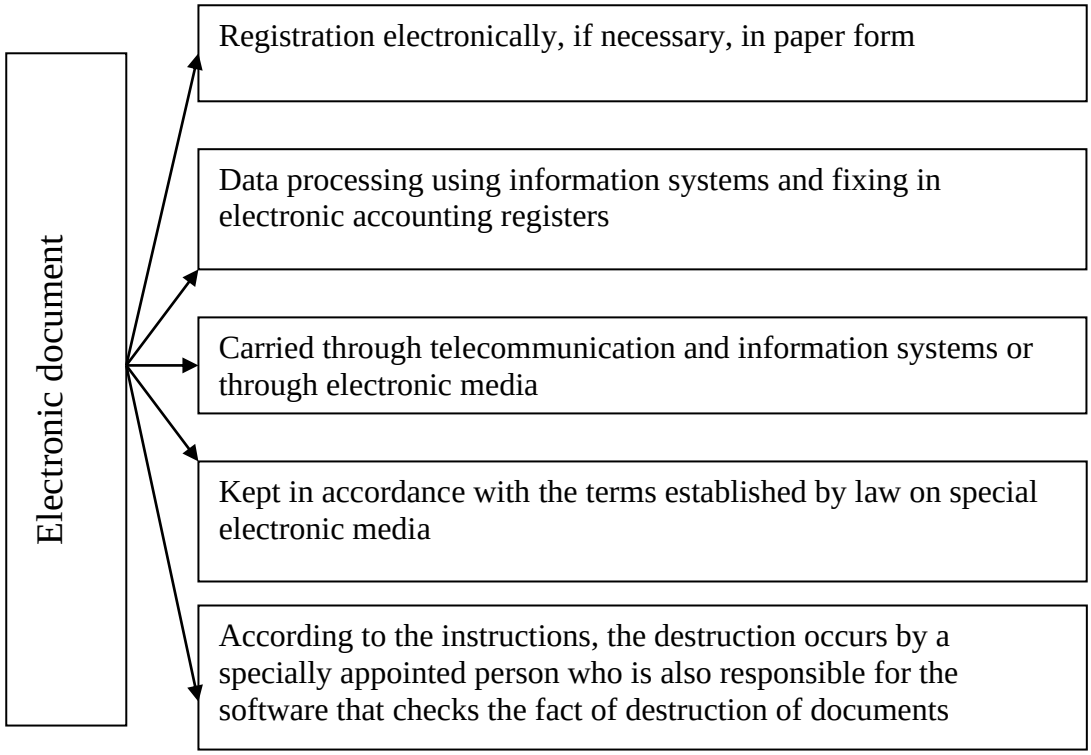

Figure 2.6. Characteristics of electronic document

Source: compiled by the authors

The electronic document can be created, transmitted, stored and transformed by electronic means into a visual form. According to Art. 5 of the Law of Ukraine "On Electronic Documents and Electronic Document Management", the visual form of submission of an electronic document is to display the data it contains, electronic means or on paper in a form suitable for Acceptance of its content by a person [21]. That is, this type of document can be converted as needed and paper. An electronic signature is a mandatory requisite of the electronic document.

Electronic digital signature is an analogue of the authorized person and seal. The signing of the electronic document must be certified by the presence of a certificate - the key. Certificate, provides an accredited electronic key certification center. The Center confirms the signature of a particular person at the time of signing that he is valid. The procedure for certifying the reality of the Electronic digital signature is normatively approved [22]. In Table. 2.4 the features of the issue and document management of the qualified electronic signature are grouped.

Table 2.4. Features of publication and use of qualified electronic signature

Qualified electronic signature	Characteristic
Issuance	Accredited Electronic Key Certification Center Information and Reference Department of the State Fiscal Service of the Justice Organs; State enterprise "National Information Systems", etc.
Documents to receive	Conclusion of a contract for the provision of qualified electronic trust services. The list of documents is provided on the official sites of the respective Accredited Electronic Key Certification Center which chooses an enterprise
The deadline is valid	The legislative documents are not provided, qualified electronic signature but the issued by the Accredited Electronic Key Certification Center of the is two years. After the expiry of the cap, you should contact the provider
Cost	The size of the board is placed on the sites. qualified electronic signature issued by Accredited Electronic Key Certification Center is made free of charge
Issuance media	Flash carrier or optical CD/DVD carrier; Protected personal keys (Diamond-1K), Crystal-1; Seven-card of person-in case of receiving the service of Mobile ID 9Dan services are provided by operators of the mobile communication "Kyivstar", "Vodafone"

Source: compiled by the authors

Therefore, electronic digital signature is aimed at simplification and acceleration of workflow between economic entities, which, in turn, should strengthen the competitiveness of domestic enterprises, because the procedure of conclusion of civil and economic contracts, registration of export-import operations, provision of electronic banking services will be accelerated.

The proper construction of the documentation system requires professional judgment of specialists to establish the organization of document management of all these processes. IV Zhigley and S.M. Laichuk considers "document management as an information activity of information relations, which is implemented by performing certain actions over documents" [23].

Document management provides the procedure for drawing up primary documents and storage from the beginning and until the complete destruction of the document. I agree with the authors of "Document Management" - this is the movement of documents from the moment of their preparation or receipt from other enterprises to use for accounting and subsequent transfer to the archive [9, p. 59].

According to T. Butinets, "Document circulation is an organized system of creation, verification, processing and registration of all accounting documents from the moment of their preparation to the transfer in the archive after recording in accounting registers, and the process of documentation - a set of technical and methodological techniques for the creation of a document" [24, c. 8].

Document management is a holistic system of collection, processing, ordering and control over the further movement of accounting information to accounting and reporting registers, which significantly influences the efficiency of management and activity of the farm as a whole.

For the processing of large amounts of information, it is integral to create modern accounting information systems. Modern informatization is accompanied by the creation of local or regional computer networks that provide access to network resources, as well as a global network that contributes to the use of modern communications.

Under the conditions of computerization of accounting and the transition to storage of information on electronic media, the information system integrates into electronic document flow. The main norm on this is the Law of Ukraine "On Electronic Documents and Electronic Document Management".

According to the Law of Ukraine [21] “Electronic document flow (circulation of electronic documents) - a set of processes of creation, processing, departure, transmission, receipt, storage, use and destruction such documents ”[21].

Electronic document management systems reduce the time, labor and financial costs associated with the processing of information and documentation, as well as minimize the risks caused by the influence of the human factor. The main differences of electronic and paper document flow are given in Table. 2.5.

Table 2.5. Comparative characteristics of stages of electronic and paper document circulation

№	Stages Document management	Paper documents	Electronic documents
1	Creation	Design only in paper form	Registration electronically, if necessary, in paper form
2	Processing	Only manual data processing and fixation in accounting registers	Automatic data processing for by helping information systems
3	Dispatch	Departure through a branch mail or employees (couriers)	Carried out through information and telecommunication systems or through electronic media
4	Dispatch	Can take several minutes or hours, days, weeks	Can take up to a few minutes
5	Storage	Kept in accordance with the terms established by the legislation in specially designated archives	Are kept according to the deadlines, established by law, on special electronic media
6	Destruction	To be destroyed for Act by the relevant commission	Destruction occurs by a person who Responsible for the software providing that checks the fact Destruction of documents

Source: compiled by the authors

To the main advantages of electronic document circulation SA Garkusha attributes "time savings, increased transparency of the internal work of the enterprise, flexibility in the physical location of employees, improving the safety of information and documents, more adequate use of physical space and equipment, keeping the history printing, postage stamps, envelopes and shipping ”[25].

Therefore, the main advantage of electronic document circulation is that offices get rid of large volume of paper documents, and therefore problems related to their use Electronic document management systems provide the process of creating, managing, distribution of large volumes of documents on computer networks, and ensure control over the passage of documents in the institution. Most often, electronic documents are stored in special repositories or in the file system. Types of files that usually support such systems include text documents, images, spreadsheets, audio and video documents.

The use of electronic document management systems at enterprises becomes a requirement of the time of today and is a natural element of the development of a

modern company, and is also an opportunity to go to a new level of business and achieve a better result in the form of obtaining a business effect.

Information flows of service documents, which form the basis of information support of the enterprise, are varied both in form and in the method of submission. The assessment of the composition of corporate information and documentation flows indicates that for the effective development and successful implementation of any organization, the issue of optimization of document management is quite relevant, and the automation of management functions, control of processing and storage of information is of key importance.

Electronic document circulation is the process of creation, processing, processing, storage, joint use, departure, transmission and destruction of electronic documents and information contained in them within a certain information system [26, p. 34].

The organization of electronic document circulation we formed in Fig. 2.7.

The process of documenting business transactions in the computer information system of accounting is to use a methodology aimed at streamlining and processing information about accounting objects. In the context of the functioning of the computer information system, the issues of information exchange between the network nodes, which requires the optimal structure of transmitted and used arrays of accounting information, become important. It is advisable to use a universal scheme for the organization of accounting by the method of its structural modeling.

The experience accumulated in Ukraine and beyond the computerization of accounting registers shows that the current accounting system is not fully formalized and computerized.

Software products that provide a computerized solution of accounting problems in corporations, presented in the domestic market, are significantly different from each other both by representation of initial data and productive information, and according to the principles of use and methods of tying computerized jobs to specificity Accounting for industrial corporations.

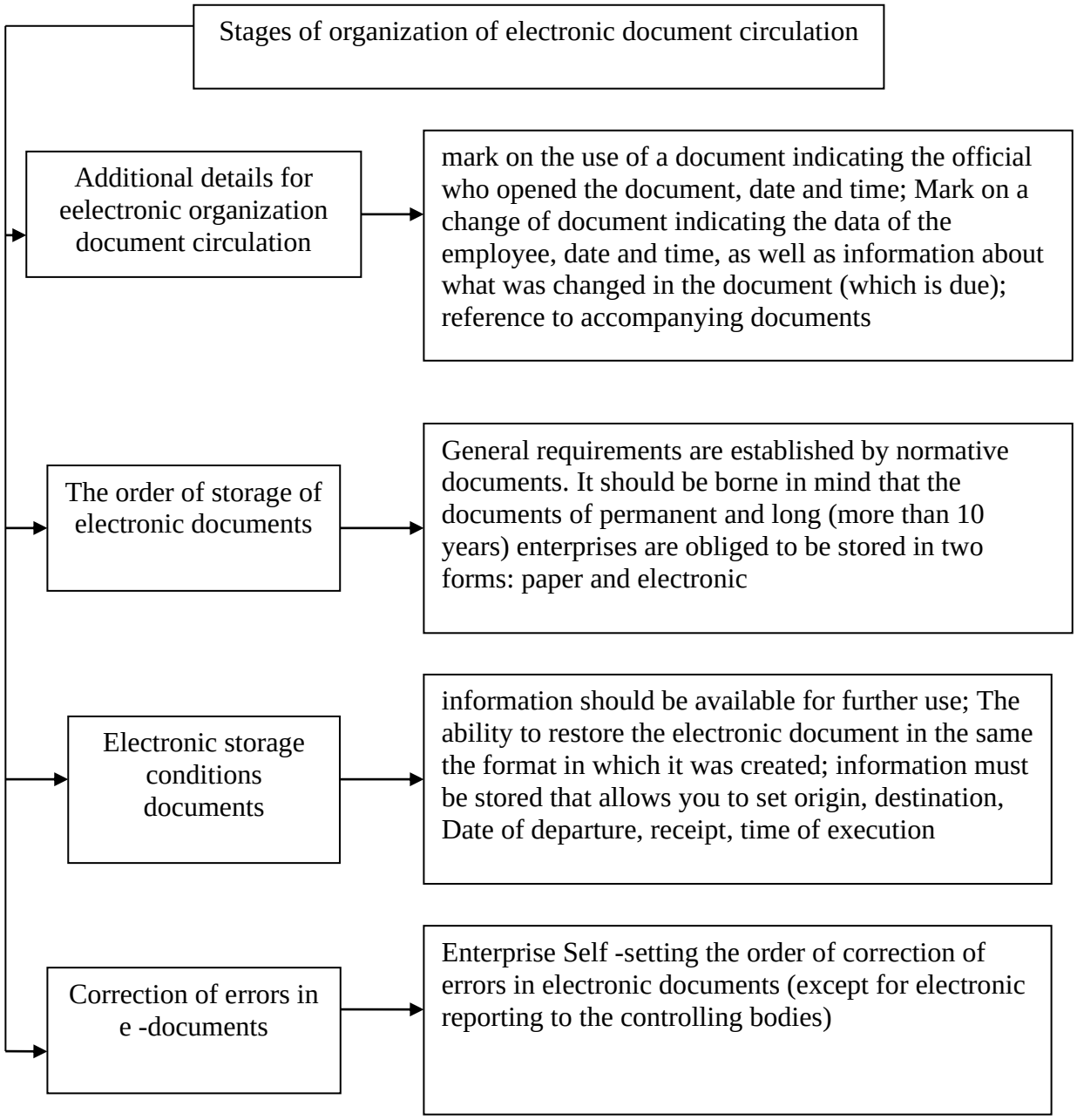

Figure 2.7. The stages of organization of electronic document circulation

Source: compiled by the authors

Corporate enterprises use high -level adaptability classes MRP, ERP, CRM. For many years, these systems are actively developing and used by suppliers: SAP, Oracle, Baan, Microsoft Business Solutions (Navision) and others. The above foreign classes apply the principle of delegating users to sufficiently broad rights to dispose of corporation resources at all levels of its management. In Ukraine, this is not always

acceptable-for reasons of poor formalization of business processes and lack of preparedness of management personnel of middle and lower levels.

Such systems are especially difficult to introduce in corporate management structures, where the main subject of staff is documents. The experience of their introduction in Ukraine has proved that in the conditions of the domestic legal field of documentation, which are supplied with foreign systems, clearly not enough for the organization of multi -stage procedures for the preparation and approval of documents on corporation resources management. There are no standards and standards for automated accounting forms.

Therefore, software products that provide automated solution of accounting problems, presented in the domestic market, are significantly different from each other both according to the representation of initial data and results, and according to the principles of use and methods of binding of ARM to the specifics of accounting of specific economic entities.

Many well-known projects on the implementation of such systems in Ukraine have to develop special means of documentary support for making decisions on corporation management and its business structures and embed them between the main modules of the system.

The workflow system in the developed computer information system is formed on the basis of a network environment. This system is focused primarily on documentary support of corporation management processes in the current legislation.

The user of the computer accounting information system receives all the benefits of a specialized documentary database with effective indexation and full-text search mechanism, as well as a complete set of intenet/intranet/extranet-technologies and all standard data protocols. This allows you to create closed corporate networks at any combination of communication channels at sufficiently low cost. Moreover, any document in the system can be available through the Internet portal.

When computerization of documentation of an economic operation, there are also two methods of grouping: according to the business transaction, according to the document and the source of its formation.

Accounting resources and corporation processes formed in the electronic document should be summarized in a timely manner, as well as to submit management within a specified time limits. Accounting data submitted later than a specified period cannot be used effectively for operational management and making appropriate decisions.

Thus, the timeliness of accounting information is a factor of qualitative preparation of accounting, tax and statistical reporting, increasing the efficiency of analysis of corporations and making management decisions, strengthening the responsibility reporting.

The process of electronic document flow is based on integrated electronic accounting information, which includes the formation of primary electronic documents, information processing and automated database. The electronic document management system provides: creation, access to and use of large flows of documents and arrays of information on computer networks, as well as controls their traffic at the enterprise.

In Ukraine, a wide range of systems of electronic document circulation of foreign and domestic developers is represented by the most used of them: "Megapolis", "Optima-Workflow", "Ascod", "Doc Prof" and "El-Dok". Electronic document circulation, perfectly interacting with BAS, Fredo Docmen and Flydoc accounting systems.

The Foss Doc electronic document management system on the Fosslook platform, designed to create an electronic document archive, corporate document management (workflow) and automation of business processes at enterprises, institutions and organizations of any kind of activity. The program makes it possible to solve a large number of tasks that are assigned to the appropriate modules. The system can be easily rebuilt taking into account the specifics of the work of each particular enterprise [27].

The assessment of the composition of corporate information and documentation flows indicates that for the effective development and successful implementation of any organization, the issue of optimization of document

management is quite relevant, and the automation of management functions, control of processing and storage of information is of key importance.

Therefore, electronic document flow is a mechanism for working with documents presented electronically for automatic reading of information. The electronic version of the document has all types of protection and provides a full document flow by all rules. Thus, it can be summarized that enterprise management is closely related to the need to introduce innovative technologies in managing information support of their activities, namely the creation and implementation of electronic document management systems, the functionality of which qualitatively solves the problems of decision -making, management, coordination, control, operational. access, convenient and quick use of service documentation.

A.O. Nikolashin emphasizes that the main directions of functioning of electronic document circulation depend on the proper implementation and use of electronic document circulation, namely: training of accounting personnel, use of more powerful equipment and improved software and technical support, etc. [28].

Consider the structure of the algorithm for the introduction of electronic document circulation in the enterprise in Figure 2.8.

The introduction of an electronic document management system at the enterprise has a positive impact on the processes of management of the enterprise as a whole, in particular, help leading managers in making effective management decisions, analysis of business processes at the enterprise; control of tasks by employees, ensuring cryptographic safety of information protection. This system involves optimizing the work of middle and lower level workers, namely: improving the quality of work of employees by reducing errors in the process of automated processing of large volume of information and data arrays; reducing the time spent on search, processing of the necessary information and documentation resources by employees of the enterprise; Convenient algorithm for the use of information resources of the enterprise. European experience and Ukrainian legislation make it possible to effectively introduce electronic document flow into private structures, using the electronic document management system on various modern platforms.

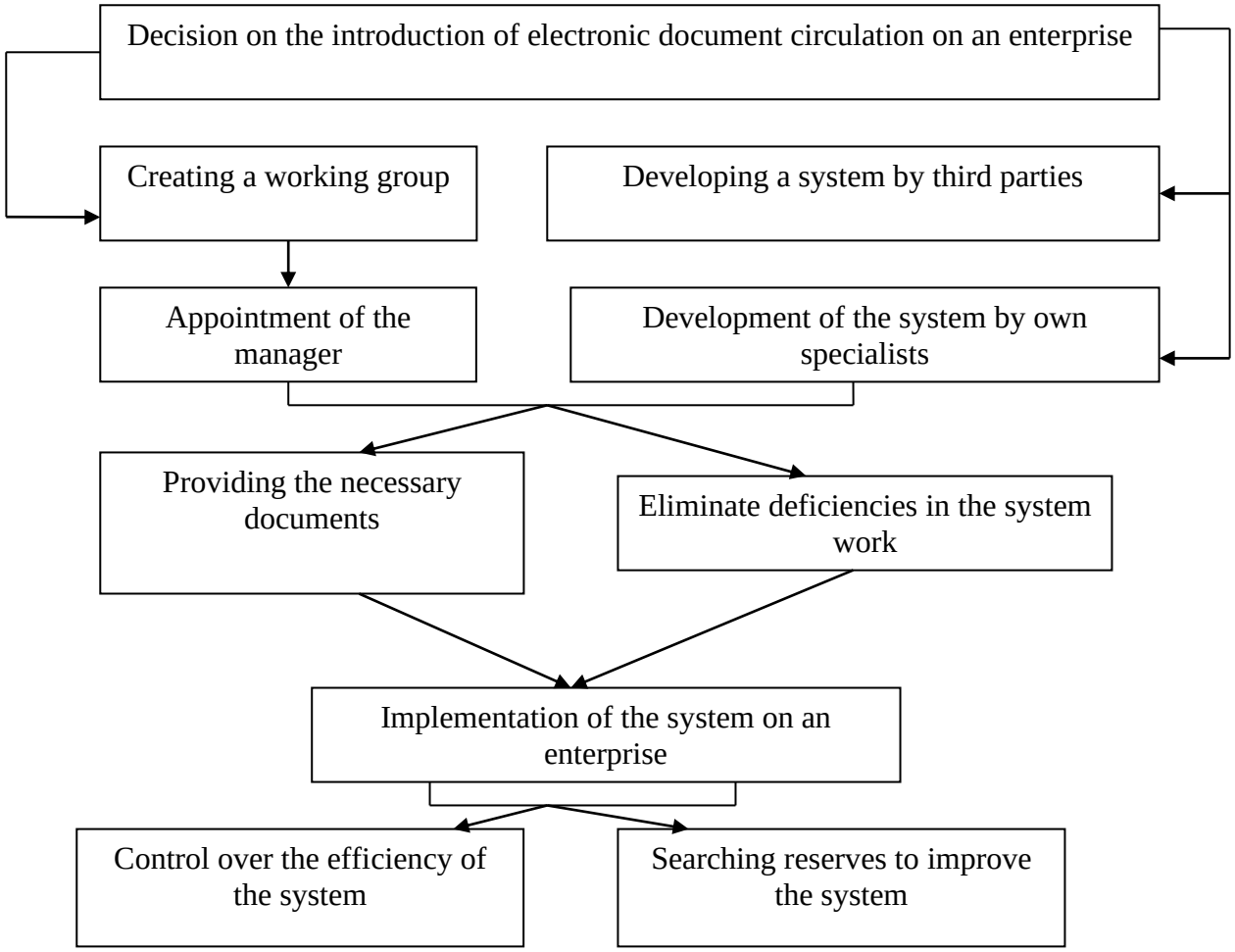

Figure 2.8. Structure algorithm for the introduction of electronic document management at the enterprise

Source: compiled by the authors

It is obvious that the transition to electronic document flow is profitable, but it is necessary to approach the mind: to develop your own instruction on the organization of electronic document flow at the enterprise, taking into account the requirements of the current legislation. Electronic primary documents have the same legal force as paper, subject to the requirement of the legislation before their registration. If one paper document and several electronic copies identical in content and details are created, then each document is considered original and has the same legal force.

The modern economic conditions require reliable information support for any economic unit. The general digitization of the information space and the modernization of accounting and taxation sphere contribute to the increase in the demand of enterprises and corporations for the digital -transformation of the

accounting system and the document management system, as well as the management of individual business processes. In this case, electronic document circulation is of extremely important importance in combination of paper primary accounting system with automated business management systems.

The process of electronic document circulation is based on integrated electronic processing of accounting and reporting information, which includes the formation of primary electronic documents, information processing and automated database.

The use of electronic document management by enterprises helps to accelerate the processes of obtaining qualitative operational information by optimizing the procedures of creation and passing of documents, well-established system of organization of accounting and rationalization of almost all business processes, creating preconditions for increasing the effective activity of individual units and enterprises as a whole.

Therefore, the problems of introduction of electronic document and electronic document circulation in Ukraine are becoming more relevant. They gain significant political and economic weight in connection with the expansion of the use of information and communication technologies in public relations, the development of electronic payment systems, e-commerce, management, etc.

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IMPROVEMENT INFORMATION AND DIGITAL COMPETENCE TEACHERS IN THE CONDITIONS OF DIGITALIZATION OF EDUCATION

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Citation:
Pylypenko, O., Shuliak, O. (2023). Improvement information and digital competence teachers in the conditions of digitalization of education. *The development of innovations and financial technology in the digital economy:* monograph. OÜ Scientific Center of Innovative Research. 2023. 230 p. PP. 147-168, https://doi.org/*10.36690/DIFTDE-2023-147-168*

Abstract. *Digital educational technologies occupy an increasingly important place among others educational technologies. Thanks to their improvement, effective training is possible remote and mixed forms, which have become predominant since the beginning of the quarantine due to the COVID-19 pandemic. Modern teachers are tasked with constantly improving their digital skills educational technologies. This is also stated in the Teacher's Professional Standard through revealing the content of the teacher's information and digital competence. Process learning can be made more interesting, varied and intensive due to combining a regular lesson with a computer, tablet or other gadget. It will allow the teacher to transfer part of his work to the gadget. The teacher can speed up the writing of definitions, theorems, and other important parts material, as the teacher does not need to repeat the text several times in this case times (the teacher displayed the text on the screen). And the student of education does not need to wait until the teacher will repeat exactly the fragment he needs. The purpose of the work is to investigate the essence of the digitalization of education, to analyze the current global educational trends and to determine the key directions of digitalization of general secondary education in EU countries and in Ukraine. The main research methods were scientific abstraction, comparative and statistical analyzes, logical generalization, structural-functional and strategic analysis for substantiation and determination of directions of digital development of general secondary education. As a result of research, it will be established that the new concept of the development of the digital economy and society for the coming years assumes that the digitalization of education is a modern stage of its informatization. Digitization of secondary education is formed depending on the trends in the development of digital and IT readiness of society. Building a robust infrastructure for learning begins with an understanding of the goals and desired outcomes that support engaging and empowering learning experiences. When based on learning goals, technology infrastructure decisions become clear. The use of digital technologies is necessary to ensure the educational needs of all participants in the educational process.*

Keywords: *digitization, secondary education, artificial intelligence, learning outcomes, Internet, educational management.*

Today, the possession of digital competences is mandatory in order to be successful in the digital society. Now the government and business have realized the need to develop measures to adapt to new realities [1]. Most modern professions today require the ability not only to communicate and collaborate with the help of gadgets, but also to process large data sets, critically evaluate information found on the Internet and other media, understand the needs of cyber security, and be able to program and manage "smart things". There is a high probability that in 5 years' society will have an acute problem of shortage of personnel who will have the necessary professional competences, including digital ones.

Digitization of education becomes an important component of the transformation of secondary education, one of the main tasks of the development of the information society. The concept of the development of the digital economy and society for the coming years assumes that the digitalization of education is a modern stage of its informatization. Saturation of the educational environment with digital devices, innovative means of learning, coverage with a high-quality Internet network will form a high-quality educational space. Digitization of secondary education is formed depending on the trends in the development of digital and IT readiness of society.

Researchers of education transformation problems pay considerable attention to the study of the formation of the state educational policy and directions of its development, part of which is the educational policy in the field of using digital technologies.

One of the steps in solving the problem of digitization of education can be considered the application of tools for comprehensive assessment of the level of digital readiness of an educational institution. According to the procedure of conducting an institutional audit in institutions of general secondary education, in accordance with the approved criteria and indicators, the educational and management processes of the educational institution and the internal system of ensuring the quality of education are assessed. Among the proposed criteria, three are highlighted that relate to the use of digital technologies (Figure 2.9).

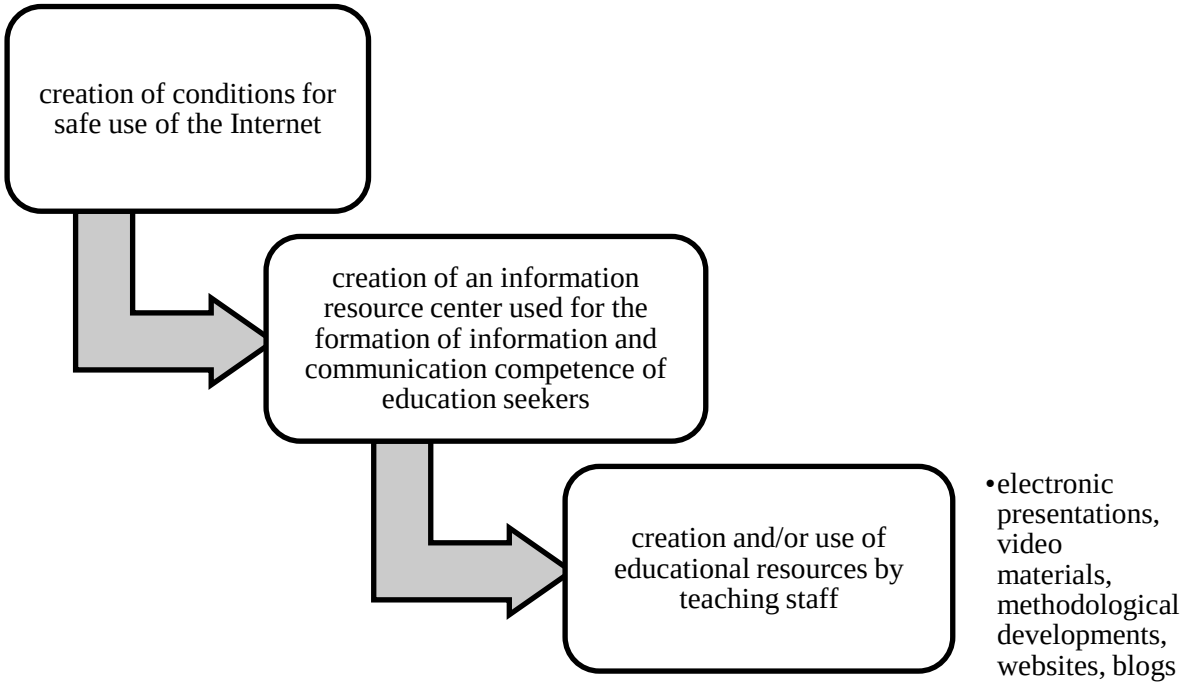

Figure 2.9. Criteria for digitalization of secondary education features [2]

At the same time, to determine the indicators of the internal system of ensuring the quality of education in an educational institution, a special tool should be developed that would allow avoiding subjective evaluation. It is obvious that such a tool should be one of the existing digital tools, the access to which is simplified and which allows a comprehensive assessment of the real state of affairs and allows the development of a strategic plan for the development of an educational institution and the determination of its educational policy, which includes its digitalization.

Such tools already exist in the world. For example, Australian National ICT Literacy [3], COMDID [4], ETS iCritical Thinking, NAEP [3], SELFIE [5].

At the heart of digital transformations are digital trends – directions in the development of digital technologies. The analysis of digital trends makes it possible to predict the development of specific economic, technological and even social phenomena in the future [6].

Drawing from Huawei's own quantitative data and real-world use cases of how intelligent technology is permeating every industry, this year's report identifies 10 megatrends currently shaping how we live and work. GIV also predicts technology

trends up until 2025, including 5G coverage, AI deployment, home robot adoption, and smart assistant use rates [7].

The 10 trends and examples of GIV's key predictions for 2025 are as follows (Table 2.6).

Table 2.6. The ten intelligent technology megatrends for 2025 [7]

Megatrends	Characteristics of the trends
1. Living with Bots	Advances in material science, perceptual AI, and network technologies are powering the uptake of robotics in a variety of home and personal scenarios. GIV predicts a 14% global penetration rate of home robots.
2. Super Sight	The convergence of 5G, VR/AR, machine learning, and other emerging technologies will let us see beyond distance, distortion, surface, and history, opening up new vistas for people, business, and culture. GIV predicts that the percentage of companies using AR/VR will increase to 10%.
3. Zero Search	As data-driven and sensor-equipped appliances and devices begin anticipating our needs, information will find us. Future searches will be button-free, personal social networks will be created effortlessly, and industry will benefit from "zero-search maintenance". GIV predicts that 90% of smart device owners will use intelligent personal assistants.
4. Tailored Streets	Intelligent transport systems will connect people, vehicles, and infrastructure, creating zero congestion, rapid emergency response, and other functions that will make life smoother. GIV predicts that 15% of vehicles will have Cellular Vehicle-to-Everything technology.
5. Working with Bots	Already transforming many industries, smart automation will take on more hazardous, repetitive, and high-precision tasks – a boon for safety and productivity. GIV predicts that there will be 103 robots in industry for every 10,000 employees.
6. Augmented Creativity	Cloud AI will cut the cost and barrier of entry to scientific experimentation, innovation, and art, opening up a goldmine of creative potential that's available to all. GIV predicts that 97% of large companies will have deployed AI.
7. Frictionless Communication	AI and big data analytics will create seamless communication between companies and customers and break down language barriers. Accuracy, understanding, and trust will underpin tomorrow's communications. GIV predicts that enterprises will fully use of 86% of the data that they produce.
8. Symbiotic Economy	Companies across the planet are adopting digital tech and smart applications on unified access platforms – that means greater collaboration, resource-sharing, stronger global ecosystems, and higher productivity. GIV predicts that every company everywhere will be using cloud technology and 85% of business applications will be cloud-based
9. 5G's rapid rollout	5G is here and it's landing far faster than any previous wireless generation – the potential for individuals, businesses, and society is enormous. GIV predicts that 58% of the world's population will have access to 5G.
10. Global Digital Governance	Advancements in digital tech must be balanced by shared data standards and principles for data use. GIV predicts that the annual volume of global data will reach 180 ZB (1 ZB = 1 trillion GB).

According to the CMO of Huawei ICT Infrastructure Kevin Zhang, "Human exploration will never stop. We should set our sights beyond what we see now and look to the future, shifting from innovation to invention. We're seeing rapid changes

to life, work, and society as every industry adopts AI, 5G, cloud computing, and other emerging technologies. Huawei is committed to building digital platforms, user experiences, and intelligent technology that power ubiquitous connectivity in every scenario. It’s our mission to offer every person, home, and organization an intelligent future and the benefits of entirely new opportunities for growth" [7].

Under such conditions, society and education must be transformed and oriented towards the future, train specialists who will turn innovations into inventions, and, therefore, produce a transformation of the educational environment, which in turn will ensure a comprehensive, competent and modern approach to the secondary education system.

The use of digital technologies is necessary to ensure the educational needs of all participants in the educational process, sustainable socio-economic development of educational institutions and the country as a whole. Today, citizens' digital abilities and skills are not just means of improving the life of society, but the main products of the country's economic activity. Moreover, these skills are the main resources of the information society, which directly affect the economic well-being and social development of the state. Digital technologies serve as a tool for access to continuous learning, which is necessary for the successful involvement of all population groups in the information society.

Digital literacy and information culture have become the key to a person's successful professional activity. The more attention is paid to this issue in secondary education institutions, the more effectively students will be able to use modern tools for obtaining information data and transforming them into knowledge.

Transforming secondary education is not a quick and easy process. This stage requires the deep interest and collaboration of all participants in the process: educators, parents, public leaders and business representatives. The components of this process are the mechanisms of adaptation to the changing needs of students, transparent, flexible and value-oriented educational policy.

Today, the US is a leading country in the digitalization of the education industry and the use of digital technologies for the transformation of learning that defines

future road map for other countries. The National Educational Technology Plan is the flagship educational technology policy document for the United States. The Plan articulates a vision of equity, active use, and collaborative leadership to make everywhere, all-the-time learning possible. While acknowledging the continuing need to provide greater equity of access to technology itself, the plan goes further to call upon all involved in American education to ensure equity of access to transformational learning experiences enabled by technology [8].

The National Educational Technology plan consists of five sections (Figure 2.10):

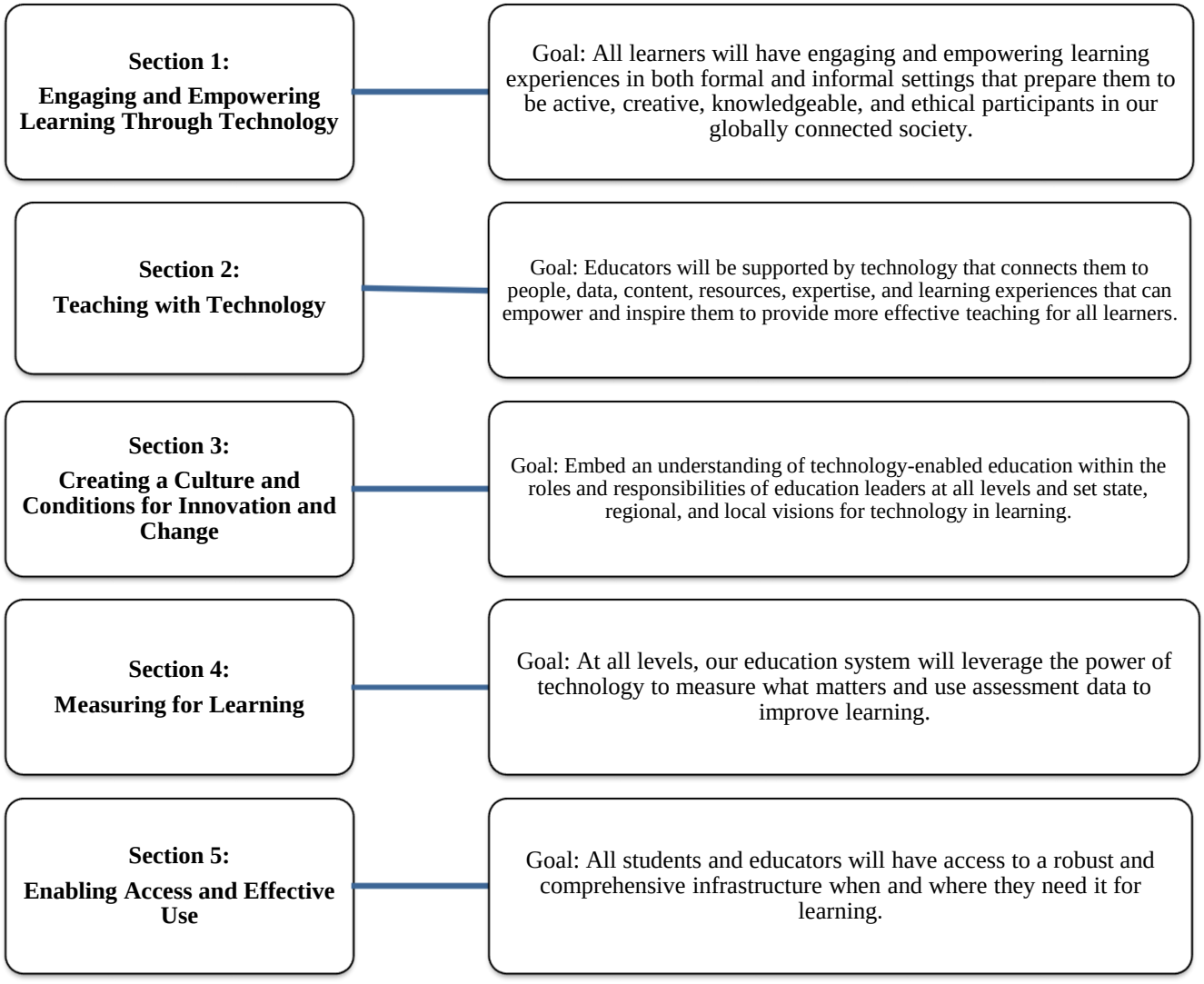

Figure 2.10. Structural division of National Educational Technology plan [8]

Section 1. To be successful in our daily lives and in a global workforce, Americans need pathways to acquire expertise and form meaningful connections to peers and mentors. This journey begins with a base of knowledge and abilities that can be augmented and enhanced throughout our lives. Fortunately, advances in learning sciences have provided new insights into how people learn. Technology can be a powerful tool to reimagine learning experiences on the basis of those insights.

Historically, a learner's educational opportunities have been limited by the resources found within the walls of a school. Technology-enabled learning allows learners to tap resources and expertise anywhere in the world, starting with their own communities. For example:

- With high-speed Internet access, a student interested in learning computer science can take the course online in a school that lacks the budget or a faculty member with the appropriate skills to teach the course.

- Learners struggling with planning for college and careers can access high-quality online mentoring and advising programs where resources or geography present challenges to obtaining sufficient face-to-face mentoring.

- With mobile data collection tools and online collaboration platforms, students in a remote geographic area studying local phenomena can collaborate with peers doing similar work anywhere in the world.

- A school with connectivity but without robust science facilities can offer its students virtual chemistry, biology, anatomy, and physics labs – offering students learning experiences that approach those of peers with better resources.

- Students engaged in creative writing, music, or media production can publish their work to a broad global audience regardless of where they go to school.

- Technology-enabled learning environments allow less experienced learners to access and participate in specialized communities of practice, graduating to more complex activities and deeper participation as they gain the experience needed to become expert members of the community.

These opportunities expand growth possibilities for all students while affording historically disadvantaged students greater equity of access to high-quality learning

materials, expertise, personalized learning, and tools for planning for future education. Such opportunities also can support increased capacity for educators to create blended learning opportunities for their students, rethinking when, where, and how students complete different components of a learning experience [8].

Section 2. Technology offers the opportunity for teachers to become more collaborative and extend learning beyond the classroom. Educators can create learning communities composed of students; fellow educators in schools, museums, libraries, and after-school programs; experts in various disciplines around the world; members of community organizations; and families. This enhanced collaboration, enabled by technology offers access to instructional materials as well as the resources and tools to create, manage, and assess their quality and usefulness.

To enact this vision, schools need to support teachers in accessing needed technology and in learning how to use it effectively. Institutions responsible for pre-service and in-service professional development for educators should focus explicitly on ensuring all educators are capable of selecting, evaluating, and using appropriate technologies and resources to create experiences that advance student engagement and learning. They also should pay special care to make certain that educators understand the privacy and security concerns associated with technology. This goal cannot be achieved without incorporating technology-based learning into the programs themselves.

For many teacher preparation institutions, state offices of education, and school districts, the transition to technology-enabled preparation and professional development will entail rethinking instructional approaches and techniques, tools, and the skills and expertise of educators who teach in these programs. This rethinking should be based on a deep understanding of the roles and practices of educators in environments in which learning is supported by technology [8].

Section 3. Taking full advantage of technology to transform learning requires strong leadership capable of creating a shared vision of which all members of the community feel a part. Leaders who believe they can delegate the articulation of a vision for how technology can support their learning goals to a chief information

officer or chief technology officer fundamentally misunderstand how technology can impact learning. Technology alone does not transform learning; rather, technology helps enable transformative learning. The vision begins with a discussion of how and why a community wants to transform learning. Once these goals are clear, technology can be used to open new possibilities for accomplishing the vision that would otherwise be out of reach. Moving to learning enabled by technology can mean a shift in the specific skills and competencies required of leaders. Education leaders need personal experience with learning technologies, an understanding of how to deploy these resources effectively, and a community-wide vision for how technology can improve learning [8].

Section 4. Measuring learning is a necessary part of every teacher's work. Teachers need to check for student understanding, and parents, students, and leaders need to know how students are doing overall in order to help them successfully prepare for college and work. In addition to supporting learning across content areas, technology-enabled assessments can help reduce the time, resources, and disruption to learning required for the administration of paper assessments. Assessments delivered using technology also can provide a more complete and nuanced picture of student needs, interests, and abilities than can traditional assessments, allowing educators to personalize learning.

Through embedded assessments, educators can see evidence of students' thinking during the learning process and provide near real-time feedback through learning dashboards so they can take action in the moment. Families can be more informed about what and how their children learned during the school day. In the long term, educators, schools, districts, states, and the nation can use the information to support continuous improvement and innovations in learning.

Continued advances in technology will expand the use of ongoing, formative, and embedded assessments that are less disruptive and more useful for improving learning. These advances also ensure that all students have the best opportunity to demonstrate their knowledge and skills on statewide assessments that increasingly focus on real-world skills and complex demonstrations of understanding. Statewide

assessment – coupled with meaningful accountability – is an essential part of ensuring students have equitable access to high-quality educational experiences. At the same time, it is crucial to focus time and effort on tests worth taking – those that reflect the kind of instructional experiences students need and that provide actionable insight.

As technology gives us the capability to improve on long-standing assessment approaches, our public education system has a responsibility to use the information we collect during assessment in ways that can have the greatest impact on learning. This means using assessments that ask students to demonstrate what they have learned in meaningful ways. And students and parents know there is more to a sound education than picking the right answer on a multiple-choice question or answering an extended-response question outside of the context of students' daily lives. All learners deserve assessments that better reflect what they know and are able to do with that knowledge [8].

Section 5. Preparing students to be successful for the future requires a robust and flexible learning infrastructure capable of supporting new types of engagement and providing ubiquitous access to the technology tools that allow students to create, design, and explore. The essential components of an infrastructure capable of supporting transformational learning experiences include the following:

- *Ubiquitous connectivity.* Persistent access to high-speed Internet in and out of school

- *Powerful learning devices.* Access to mobile devices that connect learners and educators to the vast resources of the Internet and facilitate communication and collaboration

- *High-quality digital learning content.* Digital learning content and tools that can be used to design and deliver engaging and relevant learning experiences

- *Responsible Use Policies (RUPs).* Guidelines to safeguard students and ensure that the infrastructure is used to support learning.

Building a robust infrastructure for learning begins with an understanding of the goals and desired outcomes that support engaging and empowering learning

experiences. When based on learning goals, technology infrastructure decisions become clear.

Educators from all grade-levels are coming to realize the benefits of technology in the classroom. Typically, education is one of the last industries to make extensive change, holding on to antiquated methods and practices. But through the digital transformation and the rise of educational technology, teachers have begun making drastic changes to their instruction, assessments, even the physical make-up of their classrooms, and at a much faster rate than expected. These current trends are making headlines in education because of the ways in which they are impacting student learning (Figure 2.11).

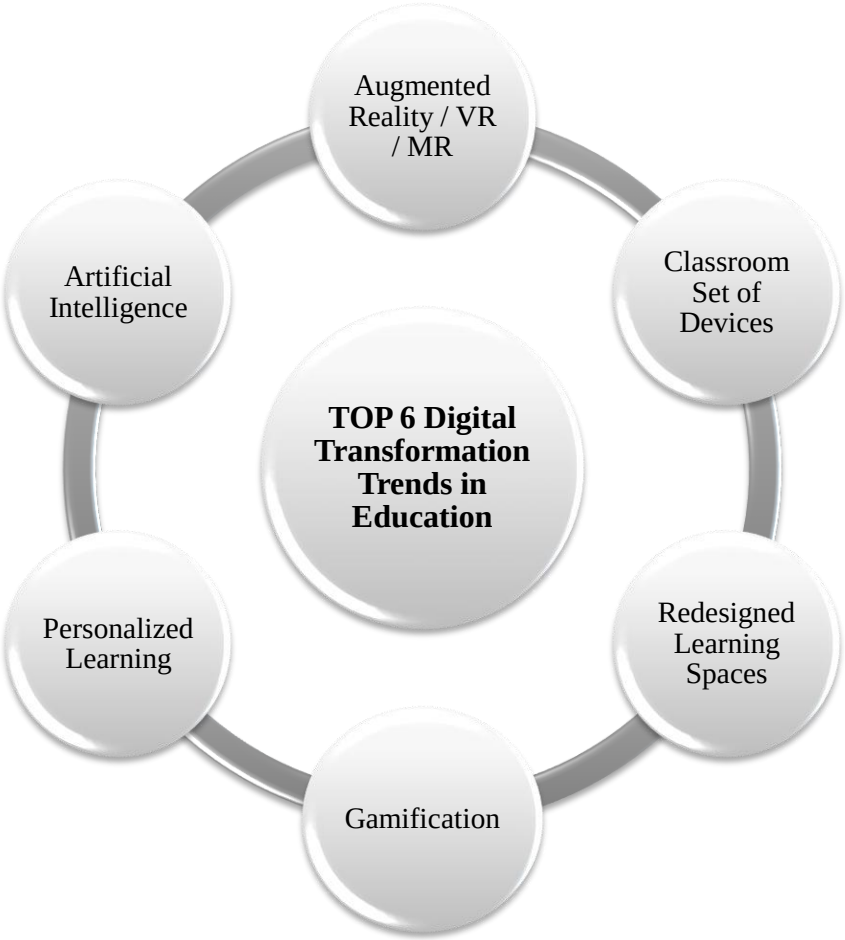

Figure 2.11. The Top 6 trends for Digital transformation in Education [9]

Augmented Reality / Virtual Reality / Mixed Reality. Gone are the days where students are expected to sit quietly at their desks. Educational technology is succeeding in making learning collaborative and interactive. Augmented, virtual, and mixed reality are examples of transformative technology that enhance teacher instruction while simultaneously creating immersive lessons that are fun and engaging for the student. Virtual reality has the capability of bringing the outside world into the classroom and vice versa. Apps such as Unimersiv can transport students to ancient Greece, while Cospaces allows students to share their virtual creations with the world. Wilkes University online adjunct professor and independent educational technologist Kathy Schrock concludes virtual reality has the potential to increase visual literacy, technology literacy, and attention to audience. The idea of combining AR/VR/MR is highly anticipated. Take, for example, the privately owned company Magic Leap. Even though it has yet to really sell anything, Magic Leap is already valued at four and a half billion dollars! This speaks to the projected endless possibilities of technology transforming classrooms.

***Classroom Set of Devices*.** Schools are moving away from BYOD, or bring your own device, and students no longer have to go to the technology lab for access to a computer or laptop. Recent years have shown an increase in classroom sets of computers that was made possible in part by federal funding. Title I schools have received funds via The Every Student Succeeds Act, and several grants and donations have outfitted classrooms all over the country with iPads and laptops for each student. Google Chromebooks account for over half of the devices in US classrooms. In 2014, more than three million Chromebooks were used in educational institutions. As that number continues to grow, so does the need for increased focus on programs that teach digital citizenship skills. Today's pervasive online environment poses exciting possibilities, ones that necessitate students are properly educated on cyber safety and individual responsibility.

Redesigned Learning Spaces. Walk into most classrooms across the country and it's unlikely you'll find rows of desk all pointing toward the front of the room. Educators have since realized their classrooms must mimic the workforce, which has

inspired them to create collaborative-friendly spaces to facilitate student learning. The onboarding of technology has supported their endeavor. 21st century classrooms are SMART boards instead of chalkboards and pods of SMART desks instead of individual seating. Students are going on virtual field trips instead of merely reading from a text; they are creating media instead of just looking at it. The redesigned learning space is laden with integrated technology, which means students aren't just using these things, but they are understanding *how* to use them in order to achieve a specific goal. Moreover, some of these learning spaces aren't even in the classroom. Colleges and universities are creating more informal campus learning spaces because they understand the importance of creating and collaborating 24/7, not just when class is in session.

Artificial Intelligence. The use of AI in higher education has already proven useful. Australia's Deaken University used IBM Watson to create a virtual student advisory service that was available 24-hours a day, seven days a week. Watson's virtual advisors fielded more than 30,000 questions in the first trimester, freeing up the actual advisors to handle more advanced issues. Another use for AI includes chatbots. Because chatbots are equipped with Natural Language Progression, as found in Siri, they have the human capability of answer questions about homework, helping students through a paperwork process like financial aid or paying bills, and easing the workload of the people who would normally serve these roles. Other applications of AI in education include personalizing learning (which is discussed in more detail below), evaluating the quality of curriculum and content, and facilitating one-on-one tutoring with the use of Intelligent Tutoring Systems. Technology doesn't aim to replace teachers, only to complement them.

Personalized Learning. We are able to personalize learning more now than ever. From school choice – public, private, charter, virtual – to the options available for *how* a student learns, education can be tailor-made to suit each individual. Blended learning gives more responsibility to the student, as it involves less direct instruction from the teacher and more discovery-based methods of learning. Blended learning is an example of how students can control certain elements of their learning

by making decisions about things like where and at what pace they move through material. Adaptive learning is similar to blended in that it, too, allows students to make decisions about things like the timeframe and path of their learning. Adaptive learning technology collects information about student behavior as they're answering questions, and then subsequently uses that information to provide instant feedback in order to adjust the learning experience accordingly. Educational tools with adaptive SEQUENCE continually analyze student data in real-time and make split second decisions based on that data. It automatically changes what comes next in a sequence, be it altered content or a different order of skills, in response to how student a student is performing. Another learning platform, Osmosis, was created by doctors for doctors and has revolutionized the way medical students study: "Using evidence-based educational concepts such as questions, flashcards, and videos, images correlated with memory anchors, adaptive spaced repetition, collaborative learning and gamification, Osmosis maximizes learning and retention." Such personalization is turning education into a "choose-your-own-adventure" method of learning, capitalizing on student interest and engagement.

Gamification. Playing and learning collide when classrooms utilize gaming as an instructional tool. Gaming technology makes learning difficult subject matter more exciting and interactive. As the technology progresses, it is quickly being used to enhance educational games in every discipline. Drexel University's Senior Vice President of Online Learning, Susan Aldridge, credits these games with mirroring real life issues, requiring students to use a valuable skillset to solve them: "These virtual game worlds provide a unique opportunity to apply new knowledge and make mission-critical decisions, while identifying obstacles, considering multiple perspectives and rehearsing various responses". Because these games are designed to provide immediate feedback, students are intrinsically motivated to keep playing them, honing skills throughout.

New technology and new learning models are exciting and offer previously unthinkable possibilities to students, but they require constant IT support. As educational institutions continue to jump on the bandwagon and adopt these digital

transformation trends, we must consider the current paradigm for technology instruction and move toward a team-based approach. As student expectations increase, responsiveness to those needs must increase as well [9].

Therefore, teachers need to master digital technologies. In particular, the use of artificial technology is an interesting and promising direction intelligence in the educational process. "Artificial intelligence is a toolkit of a system service that can be used to collect and adapt user data (or data placed in open repositories) and generate new solutions based on them or conclusions, according to the user's request. The use of artificial intelligence can help students perform common tasks in the classroom process and determine the previous level of preparation".

"Recently, the company OpenAI introduced a chatbot based on artificial of ChatGPT intelligence, which impressed users with its advanced features. ChatGPT artificial intelligence based chat bot is a specially designed neural network as a personal assistant. This chatbot can interact with the interlocutor, answer questions, prompt and give advice".

Researchers note the advantages of using artificial intelligence systems (AIS) in education:

1. Artificial intelligence systems adapt to the learning needs of each student and goals according to their strengths and weaknesses.

2. Artificial intelligence systems analyze and observe the student's current learning style and existing one’s capabilities and provide a customized content and support template.

3. Systems artificial intelligence is evaluated not only by closed answers in a test format, but also descriptive.

4. Thanks to artificial intelligence, students do not hesitate to make mistakes, which they do an integral part of learning, and then receive real-world feedback time to make the necessary corrections.

5. Adaptive learning is used students at the elementary level, and then gradually moves to the next stage, completing the previous one.

6. Artificial intelligence can give students access to education according to needs, for example by reading content to a visually impaired student.

7. Artificial intelligence can be dosed and used in preschool education for presentation of interactive games that teach and develop children's basic skills.

8. Can be used to create educational content: widely artificial intelligence programs are used, which transform the voice into text (Figure 2.12) [10].

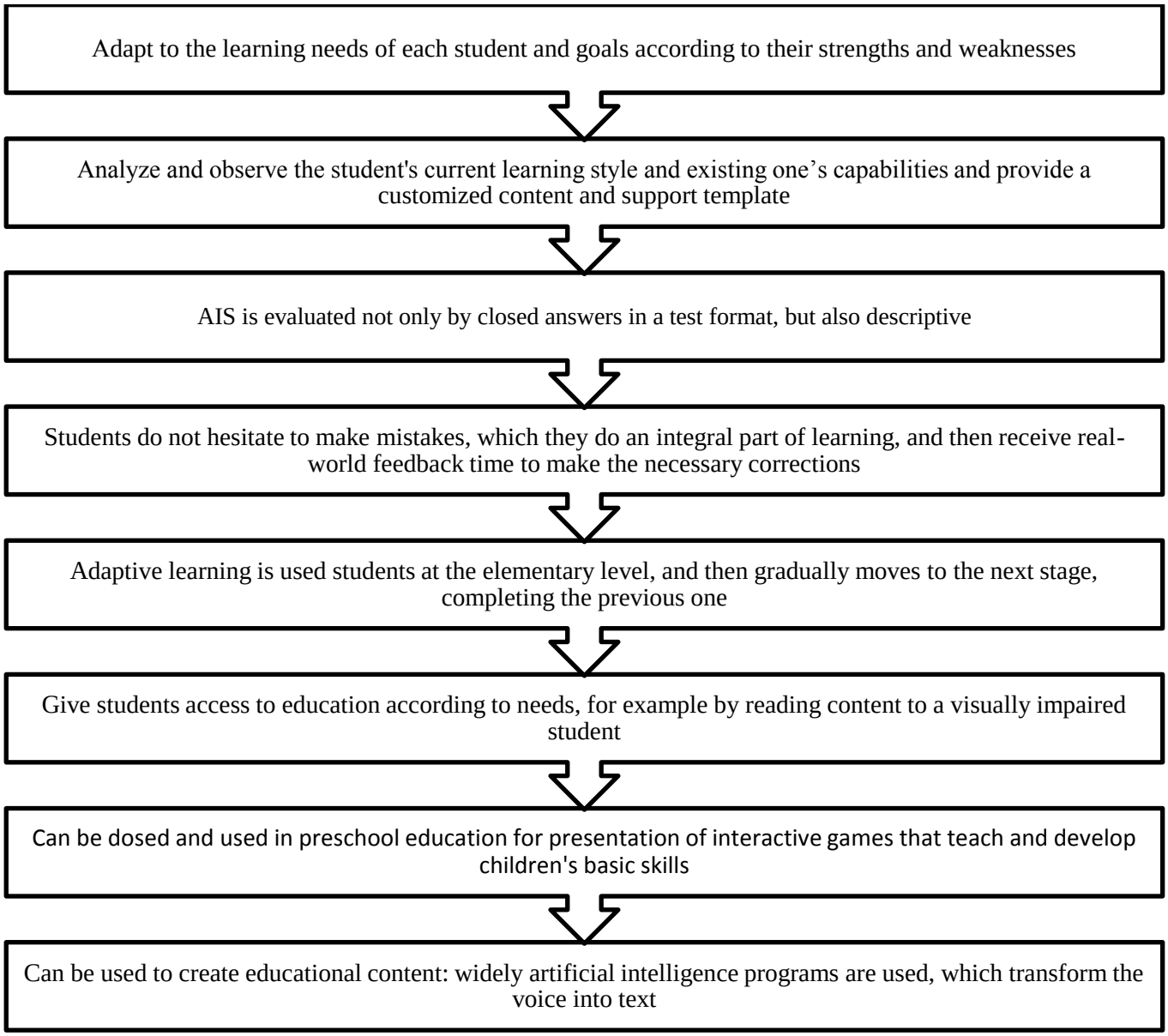

Figure 2.12. The advantages of using artificial intelligence systems in education

Source: compiled by [10]

However, the benefits are currently debated among researchers and practitioners and the harm of using artificial intelligence technology in education. One of the main and privacy is an important issue. Experts also note the disadvantages of using artificial intelligence: the cognitive abilities of both teachers and students may decrease. Too strong dependence on technology can also have negative consequences. It should be made artificial intelligence in addition to educational materials developed by the teacher. To teachers and students should not be forced to use artificial intelligence excessively.

When working with modern computer-oriented teaching aids, the possibilities of managing the process of solving didactic tasks increase, visualization of researched phenomena, processes and relationships between objects, modeling various educational situations with the help of video and audio reproduction, animation, graphics etc. Their use has a positive effect on all stages of the lesson: when studying, explaining new material, repetition, consolidation, diagnosis of students' knowledge, abilities and skills.

This contributes to increasing the motivation of students to study, revitalizing the cognitive interest, formation of key educational competencies (Fig. 2.13).

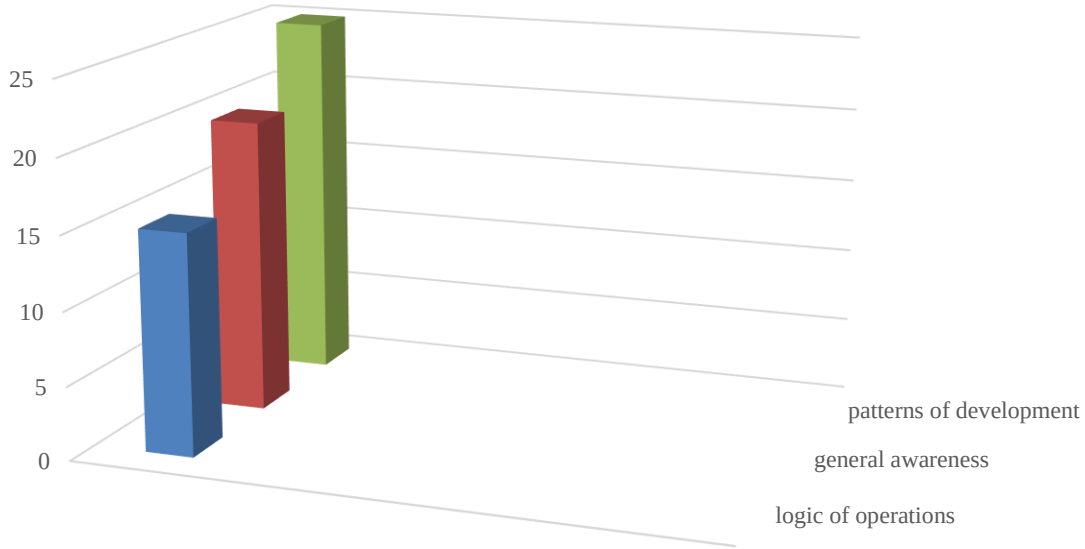

Figure 2.13. The impact of information technology on learning outcomes [11]

When using computer and digital technologies, the following results are achieved:

- the results of various logical operations are improved by 15-20%, the formation of such qualities as accuracy, precision, organization;

- awareness of the surrounding world increases by 20%;

- by 25% the awareness of subject regularities expands and deepens branches and interdisciplinary connections [11].

Computerization of general secondary education institutions of Ukraine is noted dynamic development. The share of general secondary education institutions equipped with computer equipment and connection to the Internet, demonstrates positive dynamics throughout the analyzed period. In 2020-2021, almost all (99.8%) general secondary education institutions are equipped with computers and by connecting to the Internet (Table 2.7).

Table 2.7. The state of computerization of general secondary education institutions in Ukraine, 2022 [12]

Indicators	The value of indicators
Number of general secondary education institutions, units (September 5, 2021)	13.991
Connected to the Internet general secondary education institutions, units (January 1, 2022)	13.979
- connected to the optical Internet, units	8.580
Connected to the state e-magazine, units	691
The regional and regional education departments are connected of local levels to the collection of e-reporting, %	100
Involved computer equipment, unit	62.674

An analysis of the characteristics of computer technologies and computer science shows that they are relentless intensive development, emergence of new means and renewal of existing ones. During the last years, the range of tools used in the educational process of general secondary education institutions has expanded significantly: multimedia boards, laptops, netbooks, tablets, e-books. Most of new devices have characteristics significantly different from the generally known characteristics PCs, in particular, are equipped with touch technology. Radical

changes also took place in school's boards: from wooden to multimedia and interactive panels.

Digitization permeates all components of education. In this context, educational transformation is carried out in accordance with strategic priorities that ensure quality improvement environment of teaching, learning and educational management. In Ukraine. 66% of Internet users use it to log out to the Internet smartphone, 40% – home laptop, 36% – stationary home computer, 14% – a tablet, 5% – a desktop computer at work, 4% – a work laptop (Figure 2.14).

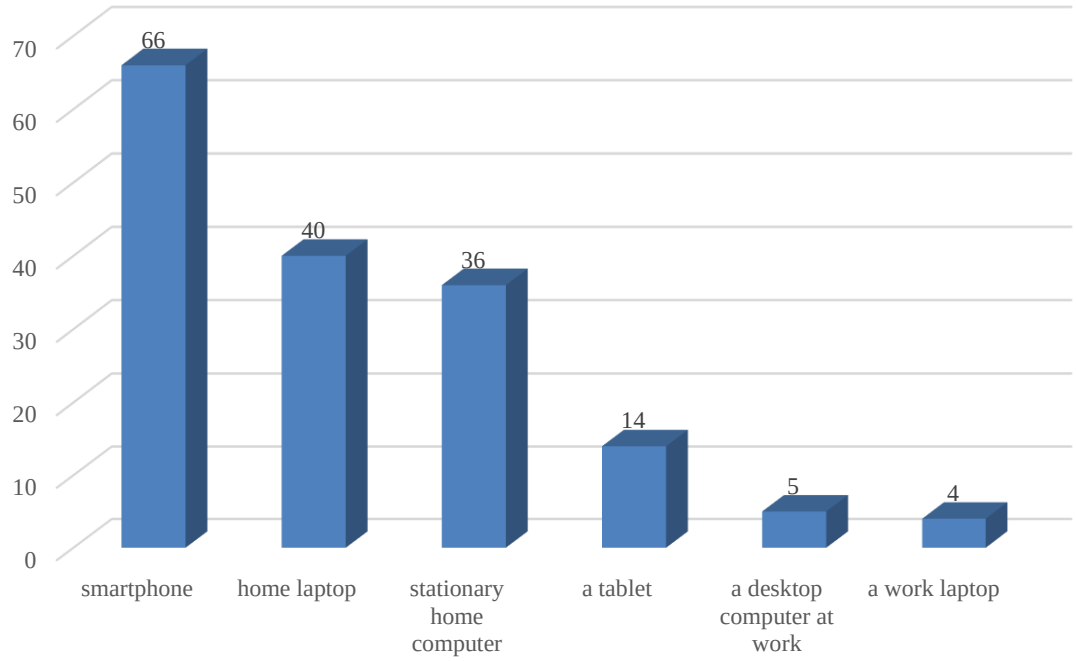

Figure 2.14. Internet access tools for education [12]

The new stage of the scientific and technical revolution, the widespread introduction of automation, computer technology and new communication systems against the background of the spread of market relations in our country has a multifaceted effect on the sphere of work, on the role and employment of man in social production [13].

Digitization of education is a modern stage of its informatization, which involves saturation information and educational environment with electronic and digital devices, means, systems and establishment of electronic communication

exchange between them, which in fact enables the integral interaction of virtual and physical, i.e. creates cyber-physical educational space.

One of the characteristic features of the innovation strategy should be ensuring close integration of production, science and education [14]. In the conditions of rapid digitalization of the economy, more and more attention is paid to the study of this issue in education as well. Most universities are actively implementing elements of distance and online education, moving to electronic document management and digitalization of educational processes [15].

The digital transformation of the general needs further research of secondary education, studying the progress and challenges achieved in solving a number of issues related to the digitalization of school education, the impact of the digital transformation of education on the personalization of learning and the expansion of educational opportunities.

Based on the analysis and generalization of the above-mentioned documents, the key areas of digitization of general secondary education common to the EU countries were identified and characterized:

1) *reliable infrastructure*, the key elements of which are high-speed connection to internet and devices available to teachers and students as needed; high-quality educational content, user-friendly tools and secure platforms that adhere to digital privacy and ethical standards; as well as professional development for teachers and manager's educational institutions;

2) *digital literacy*, including combating disinformation, basic digital skills and competences from an early age;

3) *digital competence and skills for teachers* that enable effectively and creatively use digital technologies to engage and motivate their students, support them in acquiring digital skills, ensure equal access to digital tools and platforms for all students, improving teaching, learning and assessment;

4) *assessment and assessment approaches using digital technologies* that provide new opportunities for self-reflection, feedback, and evaluation of the teaching staff and educational institution;

5) *artificial intelligence technologies in education for personalization and training efficiency*, which helps participants in the educational process to best adapt to educational needs, save time and focus on more important educational goals.

It is important for Ukraine to coordinate the directions of development of the digital transformation of education with the requirements of the world and European educational and research spaces. This means the consistent implementation of the documents defining the framework agreed upon in European countries requirements for the development of a highly effective digital ecosystem of education and the improvement of digital skills and competencies in the conditions of the digital transformation of education.

Generalization of the best experience, analysis of ways and tools of digital transformation of secondary education and organization of evaluation of all participants of the educational process on the implementation of digital technologies allows to reach conclusions:

1. The modern education system, the educational process of every educational institution, needs a digital transformation that can ensure the quality of the educational process. To ensure the effectiveness of this process, it is advisable to design an educational policy, including digitalization, at all levels of education.

2. Thanks to the rapid development of digital technologies and modern techno trends, a systematic approach to the transformation of the education system involves the complex interaction of all participants in the educational process on the way to a comprehensive systemic analysis of the digitalization of the educational process and the creation of a digital educational policy based on it.

3. Digital technologies are important educational technologies that help teachers to increase the efficiency of the educational process. Information and digital the competence of the modern teacher needs further improvement. For this, it is necessary to develop and introduce new educational programs in accordance with the pace of digital development technologies, in particular artificial intelligence technologies. Future prospects of research there is a need to investigate the issue of

possibilities the use of artificial intelligence technology in the educational process to improve its effectiveness.

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CHAPTER 3
THE DEVELOPMENT OF FINANCIAL TECHNOLOGY IN THE DIGITAL ECONOMY

DEVELOPMENT OF INNOVATIVE BUSINESS COMPANIES AND FINTECH INDUSTRY IN THE DIGITAL ECONOMY

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Citation:
Rumyk, I. Melnichenko, I. (2023). Development of innovative business companies and fintech industry in the digital economy. *The development of innovations and financial technology in the digital economy:* monograph. OÜ Scientific Center of Innovative Research. 2023. 230 p. PP. 170-188, https://doi.org/*10.36690/DIFTDE-2023-170-188*

Abstract. *The globalization of economic relations and the development of modern financial technologies require the search for new means of ensuring national interests, in the market of financial services. In these conditions, the question arises of forming a modern innovative financial system, taking into account the peculiarities both at the level of business structures and at the level of the state. In this system, the leading place as a modern means of service market development belongs to the latest financial services and tools, the implementation of which in all spheres of business activity demonstrates the importance of the development of the fintech industry. The defining trend in the development of the world economy in the 21st century was the spread of information and communication technologies, which made it possible to talk about the formation of the so-called "digital economy" and led to the introduction of the concepts of "digitalization" or "digitalization" into scientific circulation. The most extensive application of digital technologies was reflected in the financial sector, in particular, it made significant changes in the organization of circulation and trading of financial instruments. The transition to digital technologies in various fields of activity has been significantly accelerated by the COVID-19 pandemic, which has manifested itself in the sharp growth of e-commerce, increasing the pace of implementation of telemedicine, video conferencing, distance learning and financial technologies. Modern progress in the development of mobile money, financial and technological services of Internet banking can bring significant benefits to the population with low incomes and small businesses, which determines the relevance of research on the development of innovative business companies and the fintech industry in the digital economy. The purpose of the work is to study the essence of the digital economy, financial technologies; analysis of trends in the development of innovative business companies, as well as determination of the direction of influence of FinTech innovations on the development of business structures and the national economy as a whole. The main research methods were scientific abstraction, logical generalization, comparative and statistical analyzes, structural-functional and strategic analysis for substantiation and determination of directions of development of innovative companies. As a result of research, it will be established that the current stage of the development of society is determined by the formation of a new one type of economic system - digital economy, which is characterized the significant impact of information technologies on the rates of economic growth and to all spheres of the economic life of society. Traditional market participants respond to these changes by switching to innovative business models, which are an example digital and neobanks, as well as adaptation of FinTech innovations in traditional ones banking business models by creating their own FinTech units, development of partnership with FinTech companies and cooperation with other participant's market.*

Keywords*. innovative companies, FinTech, digital economy, business models, business structures, financial market participants.*

At the current stage of functioning of economic systems and society, business structures and financial companies are under the influence of digital technologies, the dynamic development of which has already led to changes in the management of most business processes and is one of the main factors of further economic transformation.

Informatization and digitization of public life covers all aspects of the functioning of the economy, therefore the transition to the digital economy should be taken into account in the management system of the national economy, and information and information and communication technologies should be considered as important components of ensuring economic growth and economic security.

The modern stage of society's development is determined by the formation of a new type of economic system - the information economy, which is characterized by the significant impact of information technologies on the rates of economic growth and on all spheres of the economic life of society.

In addition to traditional financial services that are implemented using information and communication technologies, it is worth paying attention to such a phenomenon in the financial sphere as the development of innovative financial technologies and relevant financial and technological startups that ensure that consumers receive a number of financial services online without the involvement of traditional financial intermediaries.

The defining trend in the development of the world economy in the 21st century was the spread of information and communication technologies, which made it possible to talk about the formation of the so-called "digital economy" and led to the introduction of the concepts of "digitalization" or "digitalization" into scientific circulation. The most extensive application of digital technologies was reflected in the financial sector, in particular, it made significant changes in the organization of circulation and trading of financial instruments.

Digitalization of the economy is considered a fundamental factor of economic growth, innovation and competitive environment, job creation and social progress in general [1]. The key factor of the digital economy is digital data, which allows to

multiply the volume of processed information, reduce the time for its analysis and significantly increase its efficiency for the production of technologies, goods and improving the quality of services.

Digitalization of the economy allows to achieve many positive social and economic effects. The main economic advantages of the digital economy include increasing the rate of economic growth, accelerating the development of small and medium-sized businesses, increasing the efficiency of business processes, and increasing employment in the information and technology industries. The social effects of the digitalization of the economy are: increasing the availability of financial services, reducing the cost of education due to its virtualization, improving the quality of medical care due to the digitalization of patient data, and reducing the negative impact on the environment.

Dynamic technological development and the increase in the possibilities of using information technologies in the market of financial services contributed to the development of the appropriate category apparatus. One of the most used in this context is the term "FinTech", which is used by various authors to denote FinTech innovations, FinTech services, FinTech companies, etc. The multifaceted nature and different content load of the use of the term "FinTech" has led to significant differences in the definition of this category in the scientific literature (Table 3.1).

So, the basis of classification of FinTech innovations in most scientific sources are their division according to the types of financial services they are transform: payments and transfers; services of infrastructure market participants; investment management; insurance; loans and savings; build-up capital However, FinTech innovations are not only changing individual financial products or processes, but also the financial services market as a whole, which is accompanied the appearance of new participants on it and the revision of business models of existing ones participants.

Despite the fact that there was an opportunity to develop the FinTech segment ensured by wide distribution and use of information and computer technologies, but they cannot be considered the only factor that gave rise to FinTech. Moreover, it is

worth noting that in the financial sphere manifestation of the use of technological innovations turned out to be one of the most significant, which signals the presence of additional stimulating factors spread of innovative technologies in the national financial sector economy. Therefore, it is urgent to carry out a detailed study of the complex factors that ensured the success of digitization in the financial sphere, and caused rapid development of FinTech innovations.

Table 3.1. The main approaches to the characterization of the essence of FinTech

Content of the approach	Author (source)	Definition of FinTech
FinTech as an innovation and business model	Financial Stability Board [2]	FinTech is a technology-enabled innovation in financial services that can lead to the emergence of new business models, applications, processes or products that have a significant impact on the provision of financial services.
	PwC [3]; Kovalenko V. [4]	The essence of FinTech should be defined by the relationship of two main components: innovations that are based on the technologies of the traditional banking sector; and new models of providing financial services.
FinTech as an industry	Pochenchuk H. [5]	Broadly speaking, FinTech refers to the area of the financial system of the economy that unites companies that use the latest developments to provide better financial services. In a narrower sense, FinTech is the companies themselves that belong to this industry.
FinTech as a technology	Mazaraki A., Volosovych S. [6]; Diakonova I., Pavlenko L., Kryklii O. [7]	FinTech is an innovative technology used by financial institutions, state administration bodies, trade organizations to meet the needs of consumers of financial, administrative services and goods in the context of the development of the consumer economy.
FinTech as a service	Semenog A., Tsyrulyk S. [8]	FinTech are services provided by technology companies with the help of special software, and are focused on meeting the financial needs of customers, offering convenient, efficient, automatic and transparent online products compared to classic financial services.

One of the most common approaches is the interpretation of FinTech from the point of view of a variety of innovations, and in this aspect the concept of FinTech is closest to the concept of "financial innovations". It is worth noting that unlike FinTech, financial innovations are not always associated with the adaptation of

certain information technologies to the financial services market. FinTech innovations are always technological innovations. Technological innovations that ensured the development of FinTech include: distributed access technologies (blockchain), artificial intelligence, big data analytics (Big Data), application programming interfaces, cloud technologies, biometrics [5; 9].

FinTech innovations are mostly perceived as a positive phenomenon in the development of the national economy, because they create new opportunities for economic development, expand the involvement of households and the business sector in financial relations, and increase the range of services used by economic entities. However, from the point of view of traditional financial intermediaries, in particular banking institutions, FinTech innovations can be considered as disruptive technologies.

A technology can be defined as a "disruptive technology" if its use is fundamental to a particular disruptive innovation. The developer of the theory of disruptive innovation is Clayton Christensen. According to this theory, a disruptive innovation is an innovation that uses "technology" in management, marketing, and investment policies that transforms information, labor, capital, and material resources into products or services of greater value that become the primary purpose of the company and, as a result, fundamentally changes the established "rules of the game" in many industries. Thus, certain innovations can shake the position of existing products, companies or even entire industries [10].

For example, Amazon and Aliexpress changed the way we think about e-commerce, AirBnb created a more efficient and secure rental market, and Uber transformed the taxi industry.

In the FinTech banking sector, technologies lead to the destruction of traditional business models, established models of relations with consumers, lead to the disappearance of certain types of financial services due to their transfer to the digital plane or their complete replacement by services offered by FinTech companies.

FinTech companies ensure that consumers receive a number of financial services online without the involvement of traditional financial intermediaries. Such

FinTech companies, as a rule, are not subject to the regulatory influence of the current regulatory framework, in which the existence and functioning of this type of intermediaries was not foreseen. Even without replacing traditional financial intermediaries, FinTech companies pose a challenge to the traditional financial system and to traditional approaches to managing economic processes in the country - they change the structure of financial products, ways of ensuring their provision and receipt by the consumer.

Among the types of banking services that have suffered the most disruptive impact as a result of FinTech innovations, i.e. their providers are now mainly FinTech companies, we can first mention payments and transfers, as they belong to highly profitable areas and are easily amenable to digitalization. In addition, new business models (crowdfunding platforms, peer-to-peer lending platforms) appeared and spread in the financial sector, which radically changed the financial services market of many developed countries.

According to the Capgemini report, the following levels of disruptive influence of FinTech on financial services are highlighted [11]:

– high level: payments, personal finance management;

– medium: loans, investments;

– low: basic banking services.

The replacement or disappearance of certain services from the portfolio of banking institutions is caused not only by the emergence of FinTech companies as competitors to traditional banks, but also by the development of new technologies that are qualitatively superior to existing approaches in traditional banking.

An example of the implementation of such technologies is the increasing adaptation of big data processing technologies, the development of better methods of identification and quantification of risks, the implementation of algorithm-based investments and the proliferation of platforms for users used to analyze and optimize their investment portfolios [3].

The spread of blockchain technology and its application to improve various aspects of the functioning of the financial services market has become a significant

destroyer of traditional approaches to the financial sector. The first and main direction of influence of the blockchain was the development of cryptocurrencies such as Bitcoin, which radically changed payments and money transfers by eliminating intermediaries and developing "smart" contracts (smart contracts) [3].

Examples of blockchain as a disruptive technology in the capital market are the following [12]:

1) blockchain is used for tokenization of assets and contracts, which leads to the disappearance of the need for custodians and banking services: the underlying assets are uniquely identified and form a database with the assignment of ownership rights;

2) blockchain is a universal accounting tool: it creates a universal, real-time, automatically reconciled record of ownership and transactions, taking this function away from financial intermediaries;

3) blockchain ensures self-fulfillment of smart contracts (automatic settlement of financial obligations between counterparties), turns the terms of the agreement into a "financial code" and removes the functions of financial intermediaries in servicing trade agreements; 4) the blockchain is based on cryptography and is updated by consensus, it has no central point of failure; 5) blockchain ensures the distribution of accounting functions, eliminates the need for multiple reconciliations and promotes the equality of participants: participants mutually agree on updating the database, everyone works on a copy without connecting to a central source.

The development of the FinTech sector leads to the destruction of established approaches and business models in other segments of the financial services market as well due to the emergence of on-demand insurance, peer-to-peer lending and robo-advisory services. Among FinTech companies, there are those that have experience in developing financial proposals using blockchain and offer advanced analytical solutions and provide cyber security services [13].

Therefore, FinTech is a disruptive technology for the financial sector of the national economy, which leads to a fundamental change in business models, interaction with clients and financial services themselves. All traditional financial services segments are experiencing this impact.

Summing up the analysis of the essence of FinTech, the following key characteristics can be identified:

1) compared to conventional financial innovations, the result of FinTech innovations is not only innovative financial products and technologies (processes), but also new business models of financial intermediaries and market entities - FinTech companies;

2) FinTech refers to radical innovations ("disruptive technology"), significantly changes individual financial services and the market of financial services as a whole;

3) information technology, which is often also innovative, is a mandatory basic concept that forms the basis of FinTech innovation.

Financial technologies, an abbreviated version of fintech (English — "financial technology" and "FinTech", respectively) represent a relatively new branch of the world economy and in the economic literature, this term was introduced in the 1990s together with the emergence of the worldwide Internet. The study of scientific literature leads to the conclusion that there is no unambiguous interpretation of the concept of "financial technology" (Table 3.2).

Table 3.2. The essence of the concept of financial technologies

Author	Interpretation
Schueffel, P. [14]	This is a new financial industry that uses technology to improve financial operations
Papernyk, S. [15]	It is an industry consisting of technologies for banking, corporate finance, capital markets, financial analytics, payments and personal finance management, which also includes private investments and private venture investments
Semenog, A., Kryvych, Ya., Tsyrulyk, S. [16]	These are services provided by technology companies using special software and focusing on the financial needs of clients
Tarasyuk, M., Koscheev, O. [17]	These are technologies used in the financial industry

After the global financial crisis of 2008, banks of all countries were forced to adapt to the new world. Regulators have strengthened capital requirements for banks, introduced new risk management standards and stricter requirements for KYC (Know Your Customer) and AML (Anti Money Laundering) procedures.

At the same time, technologies and innovations developed rapidly (Figure 3.1).

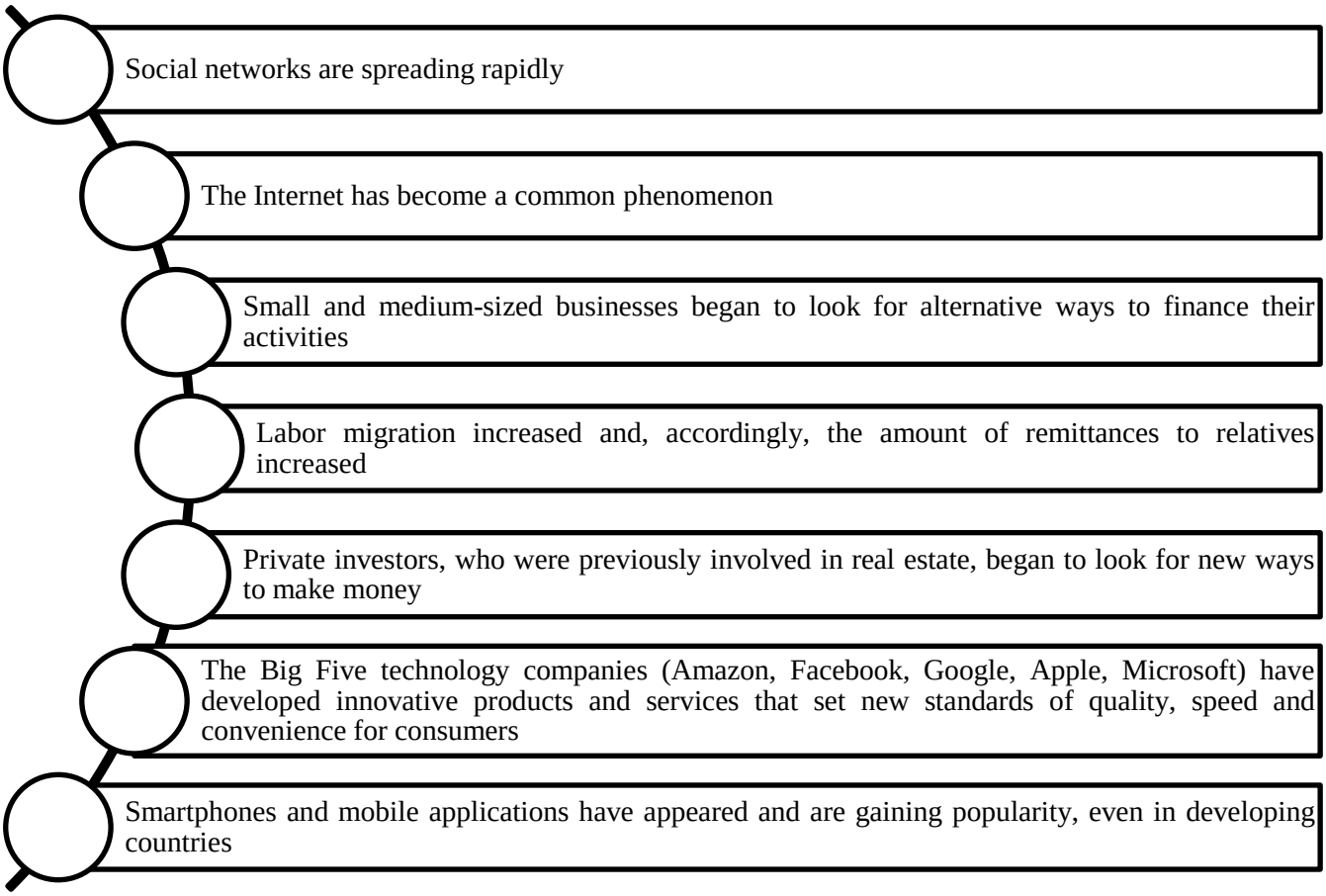

Figure 3.1. Characteristic features of the development of technologies and innovations [18]

With the emergence of new technologies, banks' focus on internal processes as a result of the 2008 crisis and the desire of users to experiment with digital services became the reasons for the emergence and growth of new FinTech companies.

The largest volume of investments was received by such sectors as: payments, lending and banking technologies. Other global trends include mobile financial services, financial and account management, money transfers, robot advisors, insurance technologies, crowdfunding, P2P lending, blockchain and cryptocurrencies.

Among FinTech companies, their own "Unicorns" have already appeared - companies worth more than 1 billion dollars. USA [19]. The main directions in which such startups are rapidly developing their business are (Figure 3.2) [18]:

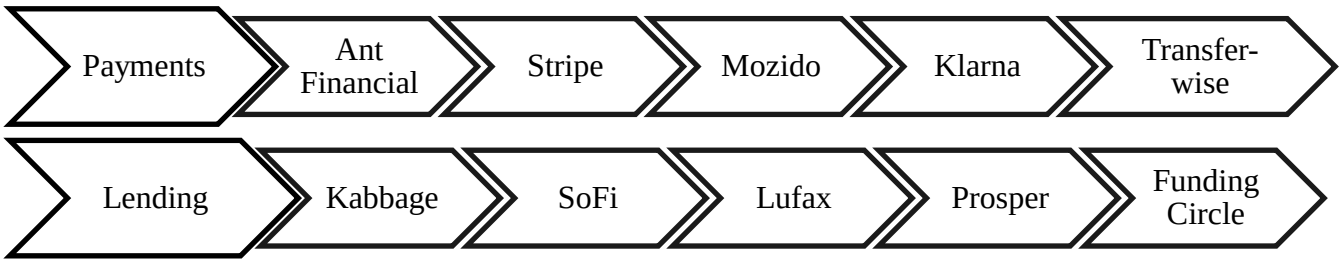

Figure 3.2. Examples of rapidly growing startups (cost more 1 billion dollars USA)

In Ukraine, FinTech is at a nascent stage and includes more than 60 companies of varying degrees of maturity. In fact, the largest FinTech example in the country was Privatbank (before nationalization), whose technological services were ahead of not only the local Ukrainian market, but also the European one. FinTech began to attract the attention of players in the financial sector of Ukraine only in 2017 after a number of events and forums dedicated to this topic.

After the financial crisis of 2008-2009, the first players among FinTech startups began to appear in Ukraine. For the most part, these projects were created in the direction of payments and transfers. The vast majority of all FinTech startups (58%) appeared since 2015.

The development of FinTech is actively supported by a number of various initiatives and measures of the National Bank of Ukraine. The National Bank of Ukraine envisages a number of initiatives (Figure 3.3).

The results of the study of Ukrainian innovative companies and business structures are as follows.

Startup founders. The founders are mostly individuals with experience in IT (65%) and finance (30%), most of whom are fluent in English. It is important to note that the top management of FinTech providers mainly consists of former bankers (70%) with experience in large commercial banks, including Privatbank, FUIB, Raiffeisen Bank Aval, Alfa-Bank and Universal Bank. About 23% of managers left the business and only 7% – from the IT sector (Figure 3.4).

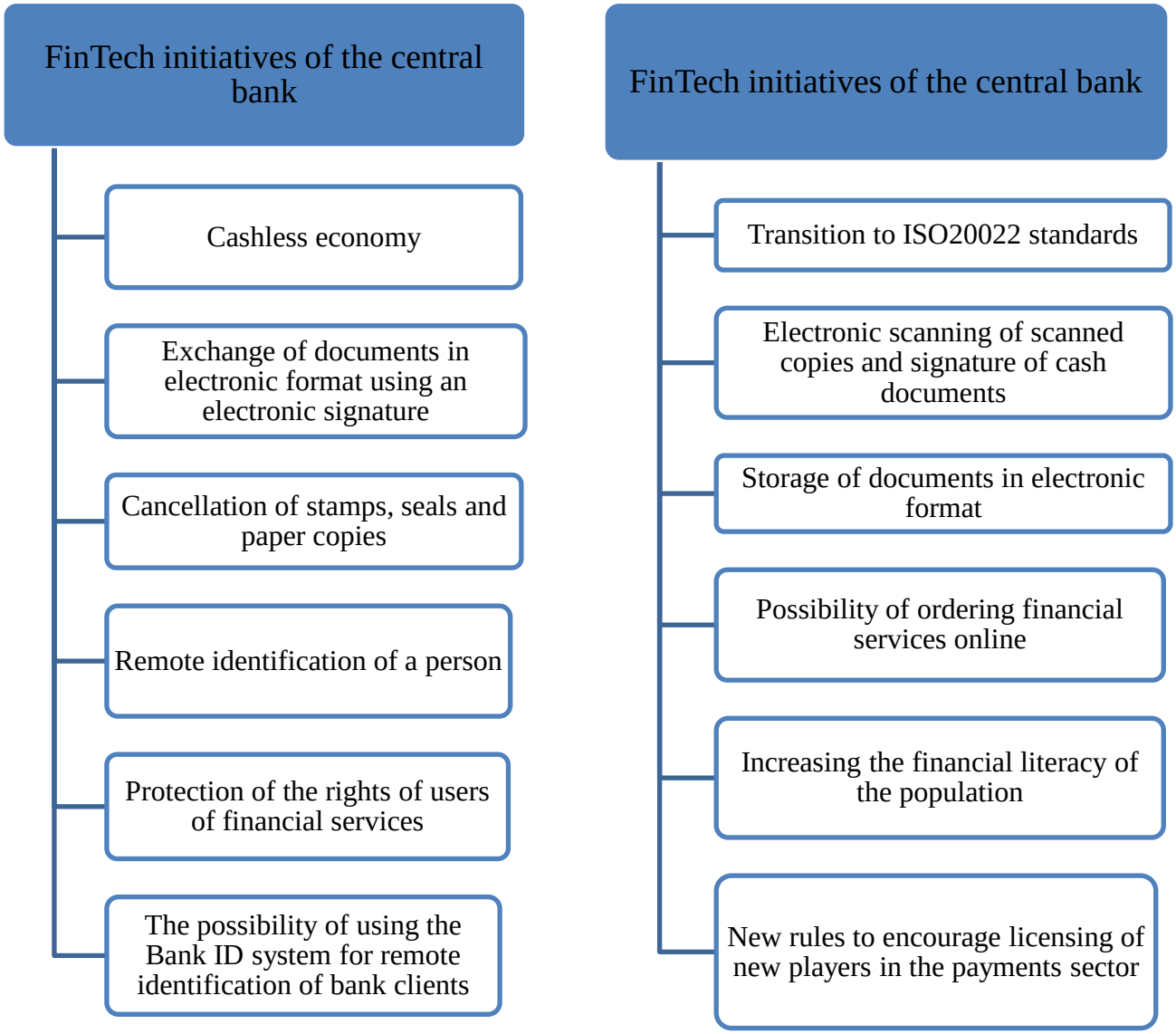

Figure 3.3. FinTech initiatives of the National Bank of Ukraine [18]

Among the important for the sector of non-financial corporations are traditional services financial intermediaries that have transformed under the influence of FinTech innovations, such as payments and settlements, lending current activity and investment. New financial technologies that are worth to take into account in entrepreneurial activity, there is a blockchain, the development of artificial intelligence, robo-consultants and big data analytics.

Division of the market into segments.

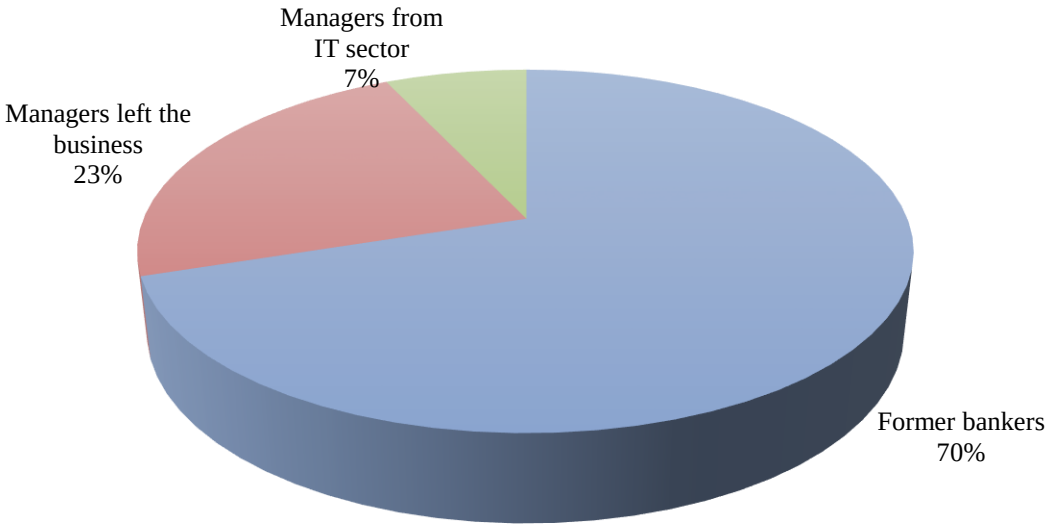

Figure 3.4. The top management of FinTech providers [18]

More than 37% of FinTech providers are engaged in the market segment of payments between legal entities (B2B) and are aimed at serving small and medium-sized enterprises (Figure 3.5):

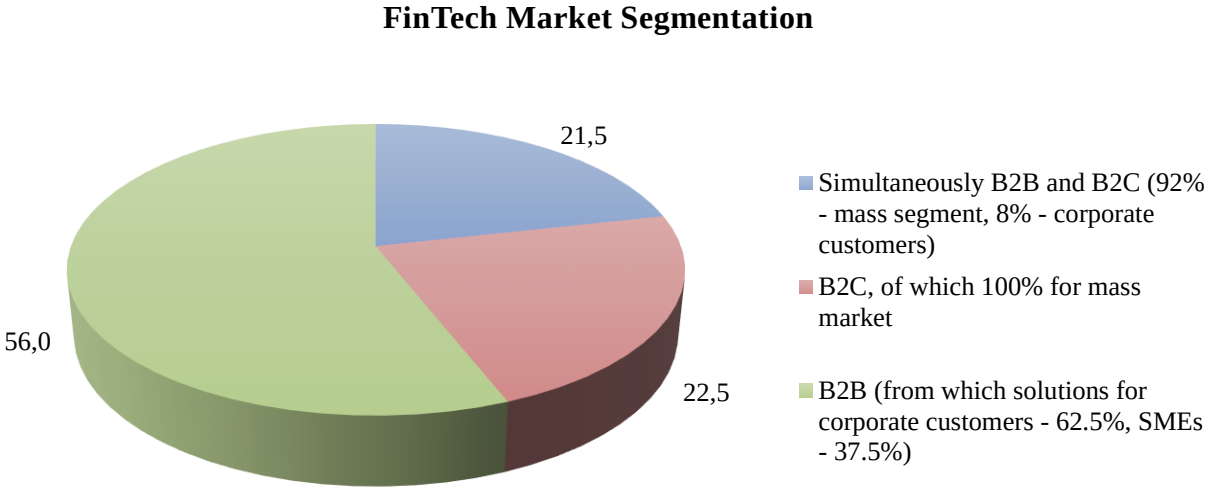

Figure 3.5. Market segmentation of financial innovations [18]

Thanks to the development of crowdfunding and peering (p2p, p2b) online platforms, the level of financial inclusion of business entities is increasing. For many

subjects of small and medium-sized businesses, as well as newly created one's enterprises that often could not count on receiving a sufficient amount of credit or acceptable financing conditions from traditional financial institutions intermediaries, crowdfunding platforms have become an alternative source investment financing, and peering platforms are an alternative source working capital financing [20].

When using crowdfunding and peering business entities take on additional risks with online platforms. Also, by posting information on a crowdfunding platform for receiving investments for an innovative project is the responsibility of the enterprise informational risk, because his innovative idea can be used by another entity.

Business models. From the point of view of business models, FinTech providers focus on receiving various commissions, although there are monthly subscription models. A small number of providers are based on a "freemium" model or a licensing model (Figure 3.6).

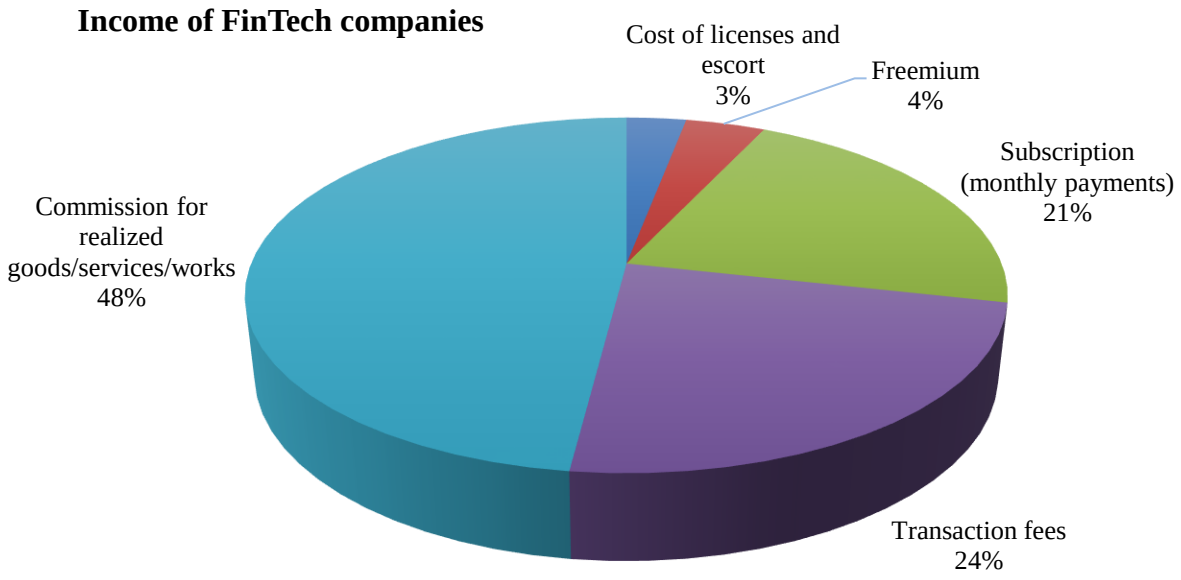

Figure 3.6. Sources of income of FinTech companies [18]

In the current activity of business entities, use is important financial services related to settlements with counterparties and receiving payments from consumers. Thanks to the emergence of mobile payments applications, online payment and

money transfer services, as well as development the cryptocurrency market, the operating conditions have been significantly simplified and improved electronic trade [21]. FinTech innovation has actually enabled businesses to serve online the full cycle of sales activities, including placement catalog, providing consultations, receiving an order, receiving payment. Using FinTech payment services allows for better management working capital of business entities, minimize receivables arrears.

Partnerships. Some of the FinTech providers support partnerships with banks and international payment systems. This includes platforms for P2P card transactions, payment cards with multiple company logos, and other payment services. Basically, these are banks such as FUIB, Oschadbank, Alfa-Bank, Raiffeisen Bank Aval, TASKOMBANK and international payment systems (Figure 3.7).

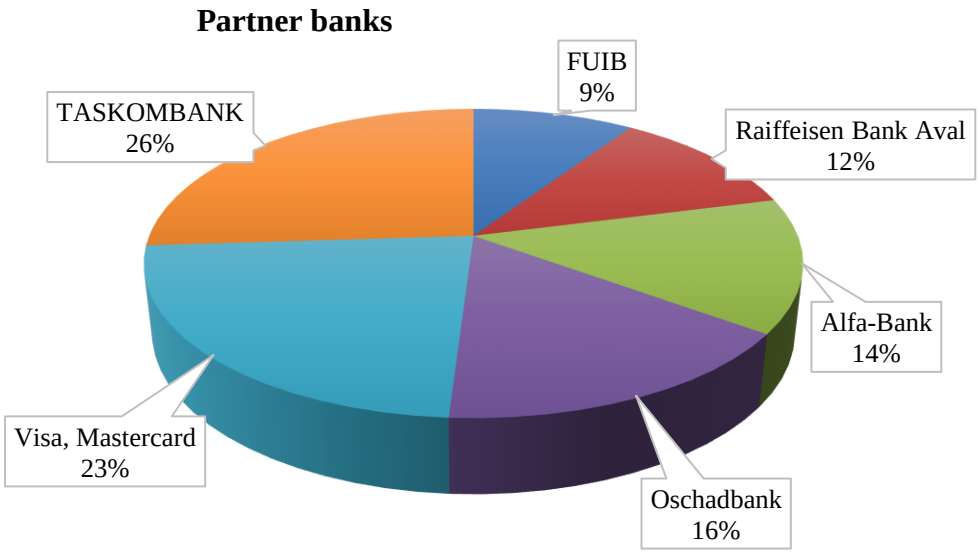

Figure 3.7. Main partner banks of FinTech companies [18]

In countries with a developed financial system, the distribution of credit resources between different categories of borrowers is balanced or close to such a state. In countries with a less developed financial system in distribution credit resources can be traced to two extremes. On the one hand, borrowers with a higher credit rating use credit services of banks, and banks, in turn, compete among

themselves for this category borrowers, offering them better credit terms. On the other hand, there is another group of borrowers with very low credit scores.

Borrowers from this group cannot get loans even if they are willing to accept a higher interest rate. In the category of borrowers from people who are employed often get a low credit rating unofficially, do not have a credit history and active deposits in the bank. These categories of borrowers represent a huge potential for development for peer-to-peer lending market, as they are not covered by banking lending.

Financing. Although many FinTech companies use their own funds to finance operations, a significant proportion (49%) seek funding from external investors (Figure 3.8).

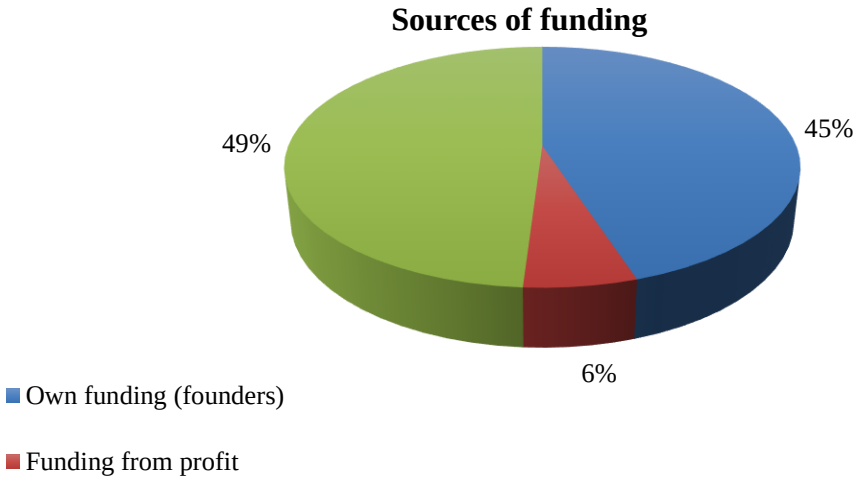

Figure 3.8. Sources of funding for FinTech companies [18]

As part of the survey, FinTech providers were asked about what topics they consider "hot" on the market. FinTech providers are among the "hot" topics identified the following: electronic banking, automation, biometric identification, machine learning and artificial intelligence (AI), forecasting and modeling, smart contracts, chat bots, blockchain, Big Data, digitization of all registers, ISO, IT security, cyber security and payment security, as well as an interest in open APIs.

Regarding topics that were "hot" but have become "cold" over the past year, FinTech providers noted electronic wallets, mobile applications, cash transactions, mobile technologies, payment cards and Internet acquiring (Table 3.3).

Table 3.3. "Hot" and "Cold" fintech topics [18]

"Hot" fintech topics		**"Cold" fintech topics**
electronic banking	automation	electronic wallets
biometric identification	machine learning	mobile apps
artificial intelligence (AI)	smart contracts	cash transactions
forecasting and modeling	chat bots	mobile technologies
blockchain & Big Date	payment security	payment cards
digitization of all registers	ISO & IT security	Internet acquiring
open APIs	cyber security	X

The FinTech sector was overlooked by financial authorities for a long time regulation and supervision, as the priority of regulatory influence was determined system forming banks and other financial intermediaries. From this point of view, they are separate financial innovation and FinTech companies were considered to be significantly unable influence the stability of the economic situation, and therefore do not need application of special regulatory measures ("too-small-to-care"). In fact, the development of the FinTech market in recent years has demonstrated exponential, not linear, growth, which became a real challenge for public administration sector.

In fact, at the current stage, the size of FinTech segment is so large that its decline or inefficiency is significant will affect the state of the entire financial system ("too-big-to-fail").

Challenges for the development of the FinTech market in Ukraine:

- Legislative and regulatory field;
- A traditional banking sector that is slow to innovate;
- Absence of open ARIs in the banking system;
- FinTech providers' limited access to capital and funding.

To date, the methods of consideration and use by the state FinTech innovation in its activities includes three main areas: reactive regulation, RegTech and proactive regulation.

Reactive regulation involves legislative development and implementation regulatory influence of the state on the FinTech segment: in the public sector requirements for the functioning of new entities - FinTech - are being formed companies, to new types of FinTech services, conditions for the protection of rights are provided consumers, investors and other market participants.

The second direction is the use of FinTech in providing public services, ensuring the functioning of the public sector, proceedings regulatory and supervisory activities, in particular for carrying out financial monitoring, control of individual financial operations, national organization payment system, electronic tax administration, application electronic identification technologies. An important place in this direction is occupied by RegTech (or Regulatory Technology) - regulatory technologies that provide compliance of companies and organizations with new requirements of legislation and their compliance.

The third direction of using FinTech is this proactive regulation, i.e. application of individual FinTech tools for stimulation of the economy: for example, the use of peering or crowdfunding financing as an additional source of formation investment resources of enterprises and the creation of appropriate incentives for them operating conditions. Proactive norms that allow to form proposals for innovative business exist in a number of countries around the world: in particular, in USA, Great Britain, Hong Kong.

So, the current stage of development of the financial services market is characterized not only by the increase in the level of digitalization, but also by the technology of financial services, which is manifested in the intensive development of new information technologies and creating fundamentally new types of financial services based on them and tools. The biggest transformative impact of FinTech innovations is on the sector of financial corporations, from which it follows

intersectoral transmission of this influence on three other sectors of the national economy.

The conducted research allows us to make a number of important points conclusions:

1. Despite the fairly early stage of development of the FinTech industry in Ukraine, there is significant growth in the industry with the potential to continue this trend in the future.

2. A strong infrastructure in the form of high mobile and smartphone penetration combined with a well-educated and technologically literate population will help accelerate the development of FinTech.

3. Given the existing demand in the market, FinTech solutions that will be focused on financial inclusion and the mass market have the greatest potential for growth in the future.

4. The implementation of the "learn by testing" approach or the so-called "regulatory sandbox" will help the advancement of FinTech. And legislative and regulatory changes will "catch up" with this development.

5. Continuation of the harmonization of the legal field of Ukraine with the Directives of the European Union regarding electronic money, remote opening of accounts, multi-level identification of customers (KYC), PSD2, open ARIs and the use of third parties as agents may further contribute to the development of the FinTech industry in Ukraine.

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BLOCKCHAIN TECHNOLOGIES IN DIGITAL ECONOMY: ADVANTAGES AND CHALLENGES

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Citation:
Marchenko, V., Dombrovska, A. (2023). Blockchain technologies in digital economy: advantages and challenges. *The development of innovations and financial technology in the digital economy:* monograph. OÜ Scientific Center of Innovative Research. 2023. 230 p. PP. 189-206, https://doi.org/*10.36690/DIFTDE-2023-189-206*

Absract. *Blockchain technology is known as one of the most transformative technologies of recent years, revolutionizing digital transactions and data storage. Originally developed as the underlying technology for Bitcoin, blockchain has since found numerous applications beyond cryptocurrencies, such as in supply chain management, identity verification, and smart contracts. In the digital economy, blockchain has the potential to significantly impact a wide range of industries and business models, from finance to healthcare and e-commerce. Blockchain issues have been developed by researchers who have focused on blockchain as the latest digital technology capable cause profound changes in society and are, to some extent, debatable. In particular, the work examines how blockchain and decentralized platforms have the potential to be powerful tools for managing large-scale social interactions and disrupting traditional power structures. However, it also cautions that the dominance of private interests within these distributed ecosystems could lead to the emergence of a stateless global society, posing significant risks. The purpose of the work is to explore the potential applications and impacts of blockchain technology in the digital economy, and to identify the opportunities and challenges that arise from the adoption of this technology in various sectors such as finance, healthcare, supply chain management, and intellectual property. Additionally, the work aims to provide insights into the role of blockchain technology in promoting digital transformation and innovation, and to assess the potential benefits and risks associated with the use of this technology in the context of the digital economy. It has been established that the use of blockchain in intellectual property can change the way creative works are protected, managed and monetized. It found that blockchain technology can be used to provide secure and transparent ownership records, automate licensing and royalty payments, and facilitate the identification of infringing uses. The main problems and limitations created by the use of blockchain technology are systematized: scalability, compatibility and regulatory regulation. As the technology continues to develop and evolve, it is imperative that these challenges are addressed in order to realize the full potential of blockchain. We believe that while blockchain technology is still in its early stages of development, it has the potential to transform various industries by providing secure, transparent and efficient data management solutions.*

Keywords: *blockchain, supply chain management, identity verification, smart contracts.*

A key innovation of the implementation of distributed ledger technology (DLT) is a new model of trust that does not rely on the organizer's authority or the participants' trust, nor does it depend on the rules of a specific jurisdiction. In contrast to traditional systems, DLT systems generally do not require trusted third parties such as certification centers or timestamp services. Instead, the DLT system aims to act as a universal intermediary that facilitates direct interaction between transaction parties.

Several countries are already utilizing blockchain solutions to ensure the credibility of electronic data and documents independently of the state and specific commercial organizations. Notably, in a Bitcoin-style blockchain system, there is no official owner, jurisdiction, or operator that can be held accountable or accountable for claims and complaints, which can be both beneficial and detrimental depending on the circumstances and objectives.

Such uncertainty can be advantageous when attempting to bypass cross-border cooperation obstacles linked to state sovereignty and limit the ability of individual states to interfere in system management, seize information, and impose sanctions. A blockchain solution can be intentionally established as a neutral trusted intermediary "without citizenship." The absence of an official owner and operator makes it challenging for law enforcement agencies in a particular country to access the confidential information of DLT participants.

The fundamental distribution and decentralization of blockchain solutions make them highly resistant to the influence of certain states, which is why blockchain technology and distributed systems are becoming a vital new field in information technology development. They can be employed in various areas to address a wide range of problems. Blockchain technology, for example, can be adapted to carry out any transactions related to the registration, accounting, or transfer of various assets (financial, tangible, and intangible), regardless of the type, number, or geographic location of participants, potentially altering the model of public administration in the future [4].

One unique aspect of blockchain technology is the possibility of decentralized storage and processing of user and other data, making it an ideal solution for any

voting process. The technology can guarantee a considerably higher degree of security, including effective protection against cyber-attacks and misuse of personal data.

Blockchain technology can also be used in public administration systems, allowing for the maintenance of decentralized state registers, including registers of ownership of land and real estate, and serving as a file storage for massive amounts of information, enabling effective management of any assets or data through high transparency.

Blockchain is a decentralized, distributed ledger technology that provides a tamper-proof and transparent record of transactions. It has gained significant attention in recent years due to its potential applications in various fields, including finance, healthcare, logistics, and intellectual property. The technology enables secure and transparent data sharing among network participants without the need for intermediaries or central authorities.

One of the most significant features of blockchain is its immutability, which ensures that once a transaction is recorded, it cannot be altered or deleted. This makes the technology an ideal solution for applications that require high levels of security and data integrity. Blockchain operates on a peer-to-peer network, where all participants have access to the same data and can verify transactions in real-time, eliminating the need for intermediaries.

One of the key benefits of blockchain technology is its ability to provide a high level of security. Since the data is stored in a decentralized and distributed network, it is very difficult for hackers to tamper with the data. Furthermore, blockchain uses advanced cryptography techniques to ensure that the data is secure and encrypted.

Another benefit of blockchain technology is its transparency. All transactions are recorded on a distributed ledger, which is accessible to all parties. This means that there is a high level of transparency and accountability, as all parties can verify the data on the blockchain.

Blockchain technology has the potential to significantly improve efficiency in the digital economy. Since it eliminates the need for intermediaries, transactions can

be completed faster and at a lower cost. This can lead to increased productivity and lower costs for businesses and consumers.

Blockchain technology is decentralized, which means that it is not controlled by a single entity. This can help to reduce the risk of fraud and corruption, as there is no central authority that can manipulate the data.

Finally, blockchain technology has the potential to foster innovation in the digital economy. It can enable new business models, such as decentralized marketplaces and peer-to-peer lending platforms. It can also facilitate the development of new products and services that were not possible before.

As we see, the potential benefits of blockchain technology in the digital economy are numerous, but it also presents some challenges that need to be addressed.

One of the main challenges facing blockchain technology is scalability. As more users join the network, the number of transactions increases, which can lead to slower transaction times and higher fees. This is a particular challenge for public blockchains, which have many users.

Another challenge facing blockchain technology is regulation. Many countries have yet to develop a clear regulatory framework for blockchain and cryptocurrencies. This can make it difficult for businesses to operate in this space.

Blockchain technology is still in its early stages, and there are many different blockchain platforms and protocols. This can make it difficult for different blockchains to communicate and interact with each other.

Finally, blockchain technology can present challenges for energy consumption. The process of mining cryptocurrency requires a significant amount of computing power, which can be energy-intensive. This can lead to high energy costs and a large carbon footprint.

Considering the advantages and challenges posed by blockchain technology, there exist several domains where it has been actively implemented.

In contemporary business operations, ***supply chain management*** (SCM) has become a crucial component, encompassing intricate networks of suppliers,

manufacturers, distributors, and retailers. Nevertheless, conventional SCM systems frequently encounter issues of insufficient transparency, accountability, and security, resulting in operational inefficiencies and challenges. As a possible resolution to these problems, blockchain technology has surfaced, providing a decentralized, immutable, and secure platform to document and validate transactions throughout the supply chain. The current scientific work examines the potential advantages and hurdles of incorporating blockchain in SCM, with specific emphasis on its utilization in inventory management, logistics, and product tracking.

Supply chain management has become increasingly complex in the era of globalization, with companies relying on a network of suppliers, manufacturers, distributors, and retailers to deliver products and services to customers. However, traditional SCM systems often suffer from a lack of transparency, accountability, and security, leading to inefficiencies and operational challenges. For instance, inventory management can be hampered by inaccurate data, delayed information flows, and inefficient ordering processes. Logistics can be complicated by bottlenecks, delays, and errors in transportation and delivery. Product tracking can be hindered by counterfeiting, theft, and fraud. Blockchain technology offers a potential solution to these issues by providing a decentralized, immutable, and secure platform for recording and verifying transactions across the supply chain. In this work, we explore the potential benefits and challenges of using blockchain in SCM, with a focus on its applications in inventory management, logistics, and product tracking.

Blockchain is a distributed ledger technology that enables secure and transparent transactions without the need for intermediaries. It uses cryptography and consensus mechanisms to validate and record transactions, creating a tamper-proof and auditable record of all activities. Blockchain has been primarily associated with cryptocurrencies such as Bitcoin, but its potential applications extend far beyond the financial sector. In SCM, blockchain can provide a shared and transparent platform for recording and verifying transactions across the entire supply chain, improving efficiency, reducing costs, and enhancing trust.

One of the main benefits of blockchain in SCM is enhanced transparency and traceability. With a blockchain-based system, all parties in the supply chain can access the same information, creating a single source of truth for all transactions. This can reduce the risk of errors, disputes, and fraud, while also providing greater visibility into inventory levels, production processes, and delivery schedules. Blockchain can also facilitate real-time tracking of products, enabling companies to monitor their location, condition, and authenticity throughout the supply chain. This can improve product safety, reduce the risk of counterfeiting, and enhance customer trust.

Another benefit of blockchain in SCM is increased efficiency and cost savings. By eliminating intermediaries and reducing transaction costs, blockchain can streamline supply chain operations and reduce the time and cost of transferring goods and services. Blockchain can also enable automated and self-executing smart contracts, which can automatically trigger payments and orders based on predefined conditions, reducing the need for manual intervention and reducing the risk of errors.

Despite its potential benefits, blockchain in SCM also faces several challenges. One of the main challenges is the integration with existing systems and processes. Many SCM systems are highly complex and fragmented, making it difficult to integrate blockchain without significant disruption. Moreover, blockchain technology is still relatively nascent, and there is a lack of standardization and interoperability across different platforms and protocols.

Another challenge is the scalability of blockchain in SCM. As the number of transactions and participants in the supply chain grows, blockchain systems can become slower and more expensive to operate, requiring significant computational resources and energy consumption.

Identity verification is a critical process in the modern digital world, and with the advent of blockchain technology, it has become easier and more secure. Blockchain is a distributed ledger technology that enables decentralized verification and management of transactions. The unique characteristics of blockchain, such as

immutability, transparency, and decentralization, make it an ideal platform for identity verification.

Identity verification using blockchain involves creating a digital identity that is stored on the blockchain network. The digital identity consists of a set of attributes that can be verified by multiple parties. These attributes can include personal information such as name, date of birth, and address, as well as other information such as educational qualifications and work experience.

The process of creating a digital identity on the blockchain involves several steps. First, the user creates a digital identity that includes their personal information and other relevant details. This identity is then verified by a trusted third party, such as a government agency or a financial institution. Once the verification is complete, the digital identity is stored on the blockchain, where it can be accessed and verified by authorized parties.

One of the key advantages of using blockchain for identity verification is its immutability. Once a digital identity is stored on the blockchain, it cannot be altered or deleted. This ensures that the identity is secure and cannot be tampered with. Additionally, the decentralized nature of the blockchain means that there is no central authority controlling the identity verification process, which reduces the risk of fraud and ensures greater trust in the system.

Another advantage of using blockchain for identity verification is its transparency. The blockchain provides a public ledger of all transactions, which means that any authorized party can access and verify a user's digital identity. This transparency also enables greater accountability, as all transactions are recorded and can be audited if necessary.

One potential application of blockchain-based identity verification is in the financial industry. Banks and other financial institutions are required to comply with Know Your Customer (KYC) regulations, which require them to verify the identity of their customers. Blockchain-based identity verification can streamline this process, reducing the time and cost required to comply with KYC regulations.

Overall, identity verification using blockchain has the potential to revolutionize the way we verify identity in the digital age. Its unique characteristics of immutability, transparency, and decentralization make it an ideal platform for secure and trustworthy identity verification. As blockchain technology continues to evolve, we can expect to see more applications of this technology in the field of identity verification and beyond.

Smart contracts have emerged as one of the most promising applications of blockchain technology. Smart contracts are self-executing contracts that allow for the automated enforcement and performance of contractual obligations. They are implemented on blockchain technology, which provides a tamper-proof and transparent record of transactions. Smart contracts have the potential to revolutionize the way contracts are executed, as they eliminate the need for intermediaries and provide a faster, more secure, and cost-effective alternative to traditional contract execution. This work provides an overview of smart contracts, including their definition, features, advantages, and challenges. It also explores their potential applications in various sectors, such as finance, healthcare, supply chain management, and real estate.

Contracts are essential to commercial activities and provide the foundation for economic transactions. However, traditional contract execution is often slow, costly, and prone to disputes. The emergence of blockchain technology has led to the development of smart contracts, which offer a faster, more secure, and cost-effective alternative to traditional contract execution. Smart contracts are self-executing contracts that run on blockchain technology and allow for the automated enforcement and performance of contractual obligations. They have the potential to revolutionize the way contracts are executed, as they eliminate the need for intermediaries and provide a transparent and tamper-proof record of transactions.

Smart contracts are computer programs that run on blockchain technology and execute contractual obligations automatically. They are self-executing, which means that once the conditions of the contract are met, the contractual obligations are automatically performed. Smart contracts are also decentralized, which means that

they run on a peer-to-peer network and do not require intermediaries or central authorities to enforce the contract. They are also transparent, as the contract code is visible to all network participants, and tamper-proof, as the blockchain technology ensures that the contract code cannot be modified once it is deployed.

Smart contracts offer several advantages over traditional contract execution. They are faster, as they can be executed automatically once the conditions of the contract are met, without the need for manual intervention. They are also more secure, as they are encrypted and stored on a tamper-proof blockchain, which ensures that the contract code cannot be modified once it is deployed. Smart contracts are also cost-effective, as they eliminate the need for intermediaries and reduce transaction costs. They are also more transparent, as the contract code is visible to all network participants, which reduces the risk of disputes and fraud.

Despite their potential advantages, smart contracts face several challenges. One of the challenges is the complexity of the contract code, which requires specialized knowledge and expertise to develop and deploy. Smart contracts also face regulatory challenges, as they are not yet fully recognized by legal systems, which raises questions about their enforceability and liability. Another challenge is the scalability of blockchain technology, which can limit the number of transactions that can be processed by the network.

Smart contracts have the potential to revolutionize the way contracts are executed in various sectors. In the finance sector, smart contracts can be used for automated payment processing, securities trading, and insurance claims processing. In healthcare, smart contracts can be used for secure and transparent sharing of medical data and automated insurance claim processing. In supply chain management, smart contracts can be used for automated tracking and tracing of goods and automated payment processing. In real estate, smart contracts can be used for automated property transactions and automated escrow services.

Smart contracts offer a faster, more secure, and cost-effective alternative to traditional contract execution. They eliminate the need for intermediaries and provide a transparent and tamper-proof record of transactions. Smart contracts have the

potential to revolutionize the way contracts are executed in various sectors, such as finance, healthcare, supply chain management, and real estate. Despite their potential advantages, smart contracts face several challenges, such as regulatory challenges, complexity of the contract code, and scalability of blockchain technology.

Smart contracts offer several advantages over traditional contracts. First, they eliminate the need for intermediaries such as lawyers, banks, and brokers, which can reduce costs and streamline the contracting process. Second, they increase transparency and trust by providing a verifiable record of all transactions on the blockchain. Finally, they reduce the risk of fraud and errors by automating the execution of contracts.

One of the most common applications of smart contracts is in financial services. Smart contracts can be used to create automated financial instruments such as insurance policies, derivatives, and loans. For example, a smart contract can be programmed to automatically transfer funds to a borrower when certain conditions, such as the repayment of a loan, are met.

Another application of smart contracts is in supply chain management. Smart contracts can be used to track and verify the authenticity of goods as they move through the supply chain. For example, a smart contract can be programmed to automatically release payment to a supplier when a shipment of goods is received and verified as authentic by the buyer.

Smart contracts can also be used around digital identity management. Smart contracts can be used to create decentralized identity systems that are more secure and privacy-preserving than traditional centralized identity systems. For example, a smart contract can be programmed to only release certain personal information to authorized parties, such as employers or government agencies.

Despite the many advantages of smart contracts, there are also several challenges to their widespread adoption. One challenge is the complexity of writing and deploying smart contracts, which requires a high level of technical expertise. Another challenge is the lack of standardization and interoperability between

different blockchain networks, which can make it difficult to create smart contracts that can be executed across multiple platforms.

Blockchain technology has been a game-changer for the financial industry, providing numerous benefits such as increased efficiency, reduced costs, and enhanced security. The technology has disrupted traditional financial systems by enabling decentralized, trustless transactions that can be executed without the need for intermediaries.

The financial sector has witnessed a major implementation of blockchain technology in payment systems. Blockchain-based payment systems have a range of benefits compared to conventional payment systems, including faster transaction processing, lower fees, and increased security. For example, cryptocurrencies such as Bitcoin and Ethereum use blockchain technology to enable peer-to-peer transactions that can be executed without the need for a central authority.

In the field of finance, blockchain technology finds additional application in capital markets, where it can facilitate more streamlined and transparent trading of financial instruments, including stocks and bonds. The utilization of blockchain-based securities can potentially result in greater efficiency and expediency in trade execution. Through the incorporation of smart contracts, trade execution can be automated, decreasing the requirement for intermediaries and enhancing the precision and speed of transactions.

Blockchain technology can also be used to create more efficient and secure record-keeping systems. For example, blockchain-based ledgers can be used to track the ownership and transfer of assets such as real estate, intellectual property, and even art. These ledgers are tamper-proof, transparent, and decentralized, making them more secure and less susceptible to fraud or hacking.

The financial sector has recognized the potential of blockchain technology as a viable solution for identity management. By utilizing blockchain-based identity systems, personal data can be managed in a more secure and private manner, thereby diminishing the risk of fraud, including identity theft. The systems can be leveraged

to authenticate the identity of individuals and organizations, ensuring secure and efficient access to financial services and other related resources.

Despite the many benefits of blockchain technology in finance, there are also several challenges to its widespread adoption. One of the biggest challenges is regulatory uncertainty, as many countries have yet to develop clear guidelines for the use of blockchain technology in finance. Additionally, the technology is still relatively new and complex, requiring a high level of technical expertise to implement and maintain.

As we see blockchain technology has the potential to transform the financial industry by enabling faster, more efficient, and more secure transactions. Its applications in payment systems, capital markets, record-keeping, and identity management offer numerous benefits to individuals and businesses alike. As blockchain technology continues to evolve, we can expect to see more innovative applications and use cases in the financial industry and beyond.

The potential impact of blockchain technology on the healthcare industry is substantial, as it offers a secure, transparent, and efficient means of managing patient data and transactions. Through the creation of decentralized systems, patients, healthcare providers, and other stakeholders can securely access and share health information.

One of the most significant applications of blockchain technology in healthcare pertains to medical records management. The deployment of blockchain-based medical records offers patients more control over their health information and allows healthcare providers to access patient records more efficiently. The use of blockchain-based medical records also has the potential to reduce errors and prevent fraud by providing a tamper-proof and auditable record of patient data.

Furthermore, blockchain technology can facilitate the creation of more efficient and secure systems for managing clinical trials. By implementing blockchain-based clinical trial management systems, the healthcare industry can enhance the security and transparency of patient data management, as well as improve monitoring of trial progress and results. Blockchain-based systems can also potentially reduce the cost

and time required to conduct clinical trials, thereby ultimately improving patient outcomes.

Another application of blockchain technology in healthcare is in the area of supply chain management. Blockchain-based supply chain management systems can enable more efficient tracking and tracing of medical products, such as pharmaceuticals and medical devices. Blockchain-based systems can also help prevent counterfeiting and ensure the authenticity of medical products.

Blockchain technology can also be used to create more efficient and secure systems for managing medical payments and insurance claims. Blockchain-based payment systems can enable faster, more secure, and more cost-effective payment processing, while blockchain-based insurance claims systems can help reduce fraud and improve the accuracy of claims processing.

Despite the many benefits of blockchain technology in healthcare, there are also several challenges to its widespread adoption. One of the biggest challenges is regulatory uncertainty, as many countries have yet to develop clear guidelines for the use of blockchain technology in healthcare. Additionally, the technology is still relatively new and complex, requiring a high level of technical expertise to implement and maintain.

The utilization of blockchain technology presents intriguing and auspicious possibilities for storing, transmitting, and managing data. Several blockchain projects have already been implemented, such as IRYO, a platform for managing electronic medical records using the EOS blockchain. CareX is another project that aims to streamline healthcare payments through its own token, which addresses the growing need for cross-border transfers and reduces reliance on cash transactions. The platform also allows token owners to store their medical information in a secure and private manner, while providing access to a chatbot with artificial intelligence for preliminary diagnoses. Additionally, SmartHealthCareToday is a platform that integrates personal medical data, including electronic medical cards and personal medical cards, with information about a patient's lifestyle and medical parameters such as blood pressure and glucose levels. The platform also allows for customized

access to health data through an in-app feature. According to research conducted by Brdt.pro lab, there are currently over 20 blockchain-based solutions for managing and storing medical data, making it the most popular field of development in the healthcare industry [9].

In conclusion, blockchain technology has the potential to transform the healthcare industry by providing more secure, efficient, and transparent systems for managing patient data, clinical trials, supply chains, and payments. Its applications in healthcare offer numerous benefits to patients, healthcare providers, and other stakeholders. As blockchain technology continues to evolve, we can expect to see more innovative applications and use cases in the healthcare industry and beyond.

The e-commerce industry holds immense potential for transformation through the use of blockchain technology, as it offers a secure, transparent, and efficient way to manage transactions and data. Decentralized systems can be established through blockchain technology, enabling stakeholders such as buyers, sellers, and other entities to securely access and share information.

One of the most notable applications of blockchain technology in e-commerce relates to payment systems. Through the utilization of blockchain-based payment systems, transactions can be processed more securely and efficiently, while also reducing fees and facilitating faster settlement times. Cryptocurrencies such as Bitcoin and Ethereum leverage blockchain technology to facilitate peer-to-peer transactions without the need for a central authority.

In addition, blockchain technology has potential applications in supply chain management within the e-commerce industry. Blockchain-based supply chain management systems can provide more efficient tracking and tracing of products, as well as transparent inventory and shipping management. Such systems also have the potential to prevent counterfeiting and ensure the authenticity of products.

Blockchain technology can also be used to create more efficient and secure systems for managing customer data. Blockchain-based customer data management systems can enable more secure and private management of customer data, reducing the risk of data breaches and other forms of fraud. These systems can also enable

more personalized marketing and customer service, ultimately improving the customer experience.

Another application of blockchain technology in e-commerce is in the area of digital identity management. Blockchain-based identity systems can enable more secure and private management of personal data, reducing the risk of identity theft and other forms of fraud. These systems can also be used to verify the identity of buyers and sellers, enabling more secure and efficient transactions.

Despite the many benefits of blockchain technology in e-commerce, there are also several challenges to its widespread adoption. One of the biggest challenges is regulatory uncertainty, as many countries have yet to develop clear guidelines for the use of blockchain technology in e-commerce. Additionally, the technology is still relatively new and complex, requiring a high level of technical expertise to implement and maintain.

The e-commerce industry holds significant potential for transformation through blockchain technology, as it offers more secure, efficient, and transparent systems for managing transactions and data. The technology's applications in payment systems, supply chain management, customer data management, and digital identity management provide a range of benefits for stakeholders such as buyers, sellers, and other entities.

As blockchain technology advances, the e-commerce industry and other sectors can anticipate more innovative applications and use cases. The transformative potential of blockchain technology in e-commerce and beyond is significant, and its adoption could lead to enhanced security, efficiency, and transparency in various domains [7].

The application of blockchain in intellectual property has been gaining significant attention in recent years. In particular, the technology can be used to verify the authenticity of ownership and store original works. Copyright ownership can be challenging to prove, especially for digital works, and monitoring usage and monetizing creative content can be difficult for authors. With blockchain, copyrights can be created automatically upon the creation of qualifying original work,

eliminating the need for registration. This enables authors to search multiple sources to identify infringing usage and make licensing easier, thus serving as an enforcement tool.

The blockchain has the potential to be utilized for intellectual property (IP) related purposes, particularly in verifying the authenticity of ownership. Proving ownership of a creative work, such as a recorded song or photograph, can be difficult due to the lack of official documentation and the burden of proof falls on the creator. With the prevalence of the internet, copyright enforcement has become even more challenging, as anyone can easily download and use creative content without permission.

In various situations, such as patenting an invention, proving the date of content creation is crucial and requires reliable evidence. Trusted timestamping protocols, which rely on asymmetric cryptography, are often used to demonstrate that data has remained unchanged since a specific point in time [8].

Blockchain can help solve the challenge of verifying copyright ownership and storing original works. It can be challenging for authors to prove ownership of their works and monitor usage, making it difficult to monetize their creations successfully. However, with blockchain, copyrights can be created automatically upon the creation of qualifying original work, eliminating the need for registration. With a blockchain-based registration system, IP owners can search multiple sources to identify infringing usage and make licensing easier, thus serving as an enforcement tool.

Another potential application of blockchain in intellectual property is the use of smart contracts, which are self-executing contracts with the terms of the agreement written into code. Smart contracts can be used to automate various aspects of the copyright process, such as licensing and royalty payments. This can reduce the administrative burden on authors and improve the efficiency of the copyright system.

In conclusion, blockchain technology represents a significant innovation in the field of decentralized and secure data management. By providing a transparent, tamper-proof and immutable ledger of transactions, blockchain has the potential to transform various industries by streamlining processes and improving data security.

The distributed nature of blockchain ensures that transactions are validated by a network of participants, eliminating the need for intermediaries and central authorities.

The potential applications of blockchain are vast and varied, with promising use cases in finance, healthcare, logistics, and intellectual property. In finance, blockchain technology has the potential to revolutionize the traditional banking system by providing a more secure and transparent platform for financial transactions. In healthcare, blockchain can be used to store and manage medical records in a secure and decentralized manner, allowing patients to have greater control over their personal data. In logistics, blockchain can improve supply chain management by providing real-time tracking and transparency.

Furthermore, the use of blockchain in intellectual property has the potential to transform the way creative works are protected, managed, and monetized. Blockchain technology can be used to provide secure and transparent records of copyright ownership, automate licensing and royalty payments, and enable easier identification of infringing usage.

Despite its potential, however, blockchain technology also presents significant challenges and limitations that need to be addressed. These include scalability, interoperability, and regulatory issues. As the technology continues to develop and mature, it is crucial to address these challenges to fully realize the potential of blockchain.

Overall, the emergence of blockchain technology represents an exciting development in the world of decentralized data management. While the technology is still in its early stages of development, it has the potential to transform various industries by providing secure, transparent and efficient data management solutions. As research and development continue to progress, it will be interesting to see how blockchain technology evolves and how it will impact society in the years to come.

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THE MAIN TRENDS IN THE DEVELOPMENT OF BLOCKCHAIN TECHNOLOGIES AND THE PROSPECTS FOR THEIR USE TO PROTECT FRAUD

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Citation:
Mihus, I., Shakhatreh, H.J.M. (2023). The main trends in the development of blockchain technologies and the prospects for their use to protect fraud. *The development of innovations and financial technology in the digital economy:* monograph. OÜ Scientific Center of Innovative Research. 2023. 230 p. PP. 207-229, https://doi.org/*10.36690/DIFTDE-2023-207-229*

Abstract. *The monograph examines the main stages of the development of blockchain technologies. The use of blockchain technologies in the activities of various companies is analyzed. The purpose of the study is to analyze the main trends in the development of blockchain technologies and the prospects for their use for fraud protection. The research methodology includes the use of the historical method to study the main stages of the development of blockchain technologies and study the practices of using blockchain by various companies. The research methodology is based on the use of data from the Report to the Nation and the results of other surveys, for a comparative analysis of types of economic fraud by volumes, periods, territorial affiliation and countermeasures. The relationship between the stages of evolution and the levels of the blockchain has been established. The main types of blockchains are systematized (public blockchains; private blockchains; semi-private blockchains; sidechains; permissioned; distributed ledger; shared ledger; fully private proprietary blockchains; tokenized blockchains; blockchains without tokens). The peculiarities of the practical implementation of blockchain technologies in the activities of companies in various sectors of the economy have been studied. A SWOT analysis was conducted that revealed that blockchain technology will undoubtedly continue to evolve, impacting many industries, including government, retail, information technology, travel, healthcare, education, agriculture, and entertainment. The 8 most risky departments in which various types of fraud occur have been identified. It was found that corruption is also the most common in each department. Thus, in the Operations Department, the second most common types of fraud are Billing (16%) and Noncash (16%); in the Accounting department - Check and payment tampering (29%); in the Executive / upper management department - Billing (31%); in the Sales Department - Noncash (18%); in the Customer service department - Noncash (17%); in the Administrative Support Department - Billing (23%); in the Purchasing - Billing department (27%); in the Department of Finance - - Billing (26%). One of the ways to improve the use of blockchain technologies should be: increasing the confidentiality of operations; scaling block chains; establishing compatibility between different blockchain systems; strengthening the security of blockchain operations; an individual approach to the use of blockchain technologies.*

Keywords: *blockchain technology; tiers of blockchain; types of blockchain; company; fraud; antifraud.*

The modern world is impossible to imagine without information technology, which actively accompanies our whole life. Unfortunately, along with their development, there are technologies that can use information about you for their own purposes. Blockchain technologies have been developed to counter such operations. Blockchain technology is a "chain of blocks", where each block is unique and has a specific reference to the previous one, which provides great difficulty in changing and / or deleting data elements.

Blockchain technology is one of the greatest innovations of the 21st century, given the impact it has on various sectors of the economy, including medicine, logistics, financial calculations, education, public administration and other areas.

Economic fraud, unfortunately, is an integral part of any business, which, in order to achieve its goals, must also fight its consequences and prevent its occurrence. The management of each company is aware of the need for such work and creates the conditions for neutralizing possible manifestations of economic fraud. The COVID-19 pandemic has significantly affected the activities of all companies and their business processes. In turn, this could not but affect the transformation of both the types of economic fraud and the tools to neutralize them.

According to S. Makridakis, A. Polemitis, G. Giaglis and S. Louca (2018), due to the significant number of benefits that blockchain can bring to each industry, its level of importance is compared with the role of the Internet in the early 1990s [1]. Researchers of the blockchain claimed that it was actively used in various fields. So, K. Fanning & D. P. Centers (2016), I. Eyal (2017), A. Simpson (2018) and others studied the use of blockchain in the financial sphere [2-4]. A. Reyna, C. Martín, J. Chen, E. Soler and M. Díaz (2018), S.-C. Cha, J.-F. Chen, C. Su and K.-H. Yeh (2018), K. Yeow, A. Gani, R. W. Ahmad, J. J. P. C. Rodrigues and K. Ko, (2018), C. Qu, M. Tao and R. Yuan (2018), S. Huckle, R. Bhattacharya, M. White and N. Beloff (2016), Y. Zhang and J. Wen (2017) and others studied the use of blockchain in the Internet of Things [5-10]. J. Zhang, N. Xue and X. Huang (2016), C. Esposito, A. De Santis, G. Tortora, H. Chang and K.-K. R. Choo (2018), M. A. Engelhardt (2017) studied the possibilities of using blockchain in health care [11-13]. R. Dennis and G.

Owen (2015), A. Schaub, R. Bazin, Omar Hasan and L. Brunie (2016), R. Dennis and G. Owenson (2016) in their works describe the impact of blockchain on business reputation [14-16]. The use of blockchain in supply chain management deserves special attention [17-19].

The rapid growth of Blockchain technology in recent years has opened up many gaps and directions for further research. However, in our opinion, it is necessary to study the study of effective practices of using blockchain technologies by companies in various industries.

The research of many scientists has studied the nature of fraud. Recent reviews of the relevant literature acknowledge that fraud is a social construction (Cooper, Dacin, & Palmer, 2013 [20]; Taylor, 2007 [21]; Toms, 2017 [22]). A study of types of fraud has shown that they differ depending on the type and financial activity (Biegelman, 2013 [23]; Goldmann, 2010 [24]). The main types of fraud in the field of company management are corporate fraud (Comer, 2003 [25]; O'Gara, 2004 [26]) and management fraud (O'Gara, 2004 [26]). The main types of financial fraud are: financial fraud (Pontell/Frid, 2000 [27]; Young, 2006 [28]; Harrington, 2012 [29]; Gough, 2013 [30]), securities fraud (Cronin/Evansburg/Garfinkle-Huff, 2001 [31]; Wang, 2010 [32]; Straney, 2011 [33]; Yu, 2013 [34]), accounting fraud (Henselmann/Hofmann, 2010 [35]; Kat/Lakeman, 2010 [36]), financial statement fraud (Zack, 2013 [37]), financial institution fraud (Pontell/Calavita/Tillman, 1994 [38]; Shepherd/Wagner/Williams, 2001 [39]), fiduciary fraud (Rosoff/Pontell/Tillman, 2014 [40]), bank fraud (Subramanian, 2014 [41]), investment fraud (Naylor, 2007 [42]), brokerage fraud (Stoneman/Schulz, 2002 [43]), and insurance fraud (Viaene/Dedene, 2004 [44]).

The most complete classification of types of fraud is presented in the materials of the Association of Certified Fraud Examiners (Table 3.4). Association of Certified Fraud Examiners (ACFE) is an anti-fraud organisation situated in USA providing training and education. ACFE has conducted detailed studies of fraudulent occurrences of financial statement frauds to recognize such financial statement which

are manipulated. ACFE has also enlisted some of the most frequently used tactics to perpetuate frauds in financial statements.

Table 3.4. Occupational fraud and abuse classification system (the fraud tree)

Type	Kind	Scheme			
Corruption	*Conflicts of Interest*	Purchasing Schemes			
		Sales Schemes			
		Invoice Kickbacks			
	Bribery	Bid Rigging			
		llegal Gratuities			
	Economic Extortion				
Financial Statement Fraud	*Net Worth/ Net Income Overstatements*	Timing Differences			
		Fictitious Revenues			
		Concealed Liabilities and Expenses			
		Improper Asset Valuations			
		Improper Disclosures			
	Net Worth/ Net Income Understatements	Timing Differences			
		Understated Revenues			
		Overstated Liabilities and Expenses			
		Improper Asset Valuations			
		Improper Disclosures			
Asset Misappropriation	*Cash*	Theft of Cash on Hand			
		Theft of Cash Receipts	Skimming	Sales	Unrecorded
					Understated
				Receivables	Write-Off Schemes,
					Lapping Schemes
					Unconcealed
				Refunds and Other	
			Cash Larceny		
		Fraudulent Disbursements	Billing Schemes		
			Payroll Schemes		
			Expense Reimbursement Schemes		
			Check and Payment Tampering		
			Register Disbursements		
	Inventory and All Other Assets	Misuse	Asset Requisitions and Transfers		
		Larceny	False Sales and Shipping		
			Purchasing and Receiving		
			Unconcealed Larceny		

Source: systematized by the author on the basis of Report to the Nation [45]

The three main types of Occupational fraud are:

1) Corruption is a scheme in which an employee misuses their influence in a business transaction in a way that violates their duty to the employer in order to gain a direct or indirect benefit (e.g., schemes involving bribery or conflicts of interest).

2) Financial statement fraud is a scheme in which an employee intentionally causes a misstatement or omission of material information in the organization's financial reports (e.g., employee files fraudulent expense report claiming personal travel or nonexistent meals).

3) Asset misappropriation is a scheme in which an employee steals or misuses the employing organization's resources (e.g., theft of company cash, false billing schemes, or inflated expense reports).

The purpose of the article is to study the main trends in the development of blockchain technologies and the prospects of their use for fraud protection.

The research methodology includes the use of the historical method to study the main stages of development of blockchain technologies and the study of blockchain use practices by different companies. Every two years, ACFE researchers publish the results of a global survey in the so-called «Report to the Nation». Based on expert assessments, this report demonstrates not only the types of fraud, but also the global losses from them. The research methodology is based on the use of Report to the Nation data and the results of other surveys presented on the ACFE website for a comparative analysis of types of economic fraud by volumes, periods, territorial affiliation and countermeasures.

We propose to begin the study of the practice of using blockchain technology by studying the main stages of its development (Fig. 3.9).

Throughout these five years, there was a growing interest in using blockchain for applications other than cybercurrency. This trend continues into 2021 as governments and enterprises look to blockchain to handle a variety of use cases. This includes voting, real estate, fitness tracking, intellectual rights, the internet of things and vaccine distribution.

Each of the described stages of development of blockchain technologies is associated with Tiers of Blockchain (table 3.5).

Table 3.4. The ratio of the main stages of development of blockchain technology and Tiers of Blockchain

Periods	Tiers of Blockchain	Description
2008-2013	Blockchain 1.0	This Blockchain is basically used for cryptocurrencies and it was introduced with the invention of bitcoin. All the alternative coins as well as bitcoin fall into this tier of blockchain. It also includes core applications as well.
2013-2015	Blockchain 2.0	Blockchain 2.0 is used in financial services and industries which includes financial assets, options, swamps and bonds etc. Smart Contracts was first introduced in Blockchain 2.0 that can be defined as the way to verify if the products and services are sent by the supplier during a transaction process between two parties.
2015-2018	Blockchain 3.0	Blockchain 3.0 offers more security as compared to Blockchain 1.0 and 2.0 and it is highly scalable and adaptable and provides sustainability. It is used in various industries such as arts, health, justice, media and in many government institutions.
From 2018 to now	Generation X	This vision the concept of singularity where this blockchain service will be available for anyone. This blockchain will be open to all and would be operated by autonomous agents

Source: systematized by the author on the basis [16-19]

The most scholars distinguish three main types of blockchain: public blockchain, permissioned blockchain, private blockchain [16-18, 46-49]. However, Blockchain has evolved greatly in the last few years and based on its different attributes, they can be divided into multiple types.

The most complete classification of blockchain types is given by Simanta Shekhar Sarmah (2020) [19]:

1. *Public Blockchains.* Public blockchains are open to the public and any individual can involve in the decision-making process by becoming a node, but users may or may not be benefited for their involvement in the decision-making process. No one in the network has ownership of the ledgers and are publicly open to anyone participated in the network. The users in the blockchain use a distributed consensus mechanism to reach on a decision and maintain a copy of the ledger on their local nodes.

2. *Private Blockchains.* These types of blockchains are not open to the public and are open to only a group of people or organizations and the ledger is shared to its participated members only.

1991

- Stuart Haber and W. Scott Stornetta published an article about timestamping digital documents.
- The article proposed a solution for preventing users from backdating or forward-dating electronic documents.
- The goal was to maintain complete privacy of the document itself, without requiring record-keeping by a timestamping service.

1992

- S.Haber andW. Stornetta updated the design to incorporate Merkle trees, which enabled multiple document certificates to live on a single block.

1998

- Computer scientist Nick Szabo works on ‘bit gold’, a decentralised digital currency

2000

- Stefan Konst publishes his theory of cryptographic secured chains, plus ideas for implementation

2008

- Developer(s) working under the pseudonym Satoshi Nakamoto release a white paper establishing the model for a blockchain
- Nakamoto's design also introduced the concept of a "chain of blocks." In fact, Nakamoto defined an electronic coin as a "chain of digital signatures," where each owner transfers the coin to the next owner.

2009

- Nakamoto mined the first bitcoin block, validating the blockchain concept. The block contained 50 bitcoins and was known as the Genesis block -- aka block 0.
- The first bitcoin transaction took place when Nakamoto sent Hal Finney 10 bitcoin in block 170.
- The first bitcoin exchange -- Bitcoin Market -- was established, enabling people to exchange paper money for bitcoin.

2014

- Blockchain technology is separated from the currency and its potential for other financial, interorganisational transactions is explored. Blockchain 2.0 is born, referring to applications beyond currency.
- Thr financial institutions and other industries began to recognize and explore its potential, shifting their focus from digital currency to the development of blockchain technologies

2015

- The Ethereum Frontier network launched, enabling developers to write smart contracts and decentralized apps that could be deployed to a live network. Ethereum was on its way to becoming one of the biggest applications of blockchain technology. It drew in an active developer community that continues to this day.
- But other important events also occurred that year. NASDAQ initiated a blockchain trial. The Linux Foundation launched the Hyperledger project. And nine major investment banks joined forces to form the R3 consortium, exploring how blockchain could benefit their operations. Within six months, the consortium grew to more than 40 financial institutions.

2016

- The word blockchain gained acceptance as a single word, rather than being treated as two concepts, as they were in Nakamoto's original paper.
- The Chamber of Digital Commerce and the Hyperledger project announced a partnership to strengthen industry advocacy and education.
- A bug in the Ethereum decentralized autonomous organization code was exploited, resulting in a hard fork of the Ethereum network.
- The Bitfinex bitcoin exchange was hacked and nearly 120,000 bitcoin were stolen -- a bounty worth approximately $66 million.

2017

- Bitcoin hit a record high of nearly $20,000. Japan recognized bitcoin as legal currency.
- Seven European banks formed the Digital Trade Chain consortium to develop a trade finance platform based on blockchain.
- The Block.one company introduced the EOS blockchain operating system, designed to support commercial decentralized applications.
- Approximately 15% of global banks used blockchain technology in some capacity.

2018

- Bitcoin value continued to drop, ending the year at about $3,800.
- The online payment firm Stripe stopped accepting bitcoin payments. Google, Twitter and Facebook banned cryptocurrency advertising.
- South Korea banned anonymous cryptocurrency trading but announced it would invest millions in blockchain initiatives.
- The European Commission launched the Blockchain Observatory and Forum.
- Baidu introduced its blockchain-as-a-service platform.

2019

- Walmart launched a supply chain system based on the Hyperledger platform.
- Amazon announced the general availability of its Amazon Managed Blockchain service on AWS.
- Ethereum network transactions exceeded 1 million per day.
- Blockchain research and development took center stage as organizations embraced blockchain technology and decentralized applications for a variety of use cases.

2020

- Nearly 40% of respondents incorporated blockchain into production, and 55% viewed blockchain as a top strategic priority, according to Deloitte's 2020 Global Blockchain Survey.
- Ethereum launched the Beacon Chain in preparation for Ethereum 2.0.
- Stablecoins saw a significant rise because they promised more stability than traditional cybercurrencies.
- There was a growing interest in combining blockchain with AI to optimize business processes.

Figure 3.9. The main stages of development of blockchain technologies

Source: systematized by the author on the basis [16-19, 46-51]

3. *Semi-private Blockchains.* In a semi-private blockchain, some part of the blockchain is private and controlled by a group or organizations and the rest is open to the public for anyone to participate.

4. *Sidechains.* These blockchains are also known as pegged sidechains where coins can be moved from blockchain to another blockchain. There are two types of sidechains naming one-way pegged sidechain and two-way pegged sidechain. One-way pegged sidechain allows movement from one sidechain to another whereas two-way pegged sidechain allows movement on both sides of two sidechain.

5. *Permissioned*. Ledger In this type of blockchain, the participants are known and already trusted. In permissioned ledger, an agreement protocol is used to maintain a shared version of the truth rather than a consensus mechanism.

6. *Distributed Ledger.* In a distributed ledger blockchain, the ledger is distributed among all the participants in the blockchain and it can spread across multiple organizations. In distributed ledger, records are stored contiguously instead sorted block and they can be both private or public.

7. *Shared Ledger.* Shared ledger can be an application or a database that is shared by public or an organization.

8. *Fully Private of Proprietary Blockchains.* These types of Blockchains are not a part of any mainstream applications and differ the idea of decentralization. These type of blockchains come in handy when it is required to shared data within an organization and provide authenticity of the data. Government organizations use private of proprietary Blockchains to share data between various departments.

9. *Tokenized Blockchains.* These are standard blockchains which generate cryptocurrencies through consensus process using mining or initial distribution.

10. *Tokenless Blockchains.* These blockchains are not real blockchains as they do not have the ability to transfer values, but they can be useful when it is not required to transfer value between nodes and there is only the need to transfer data among already trusted parties.

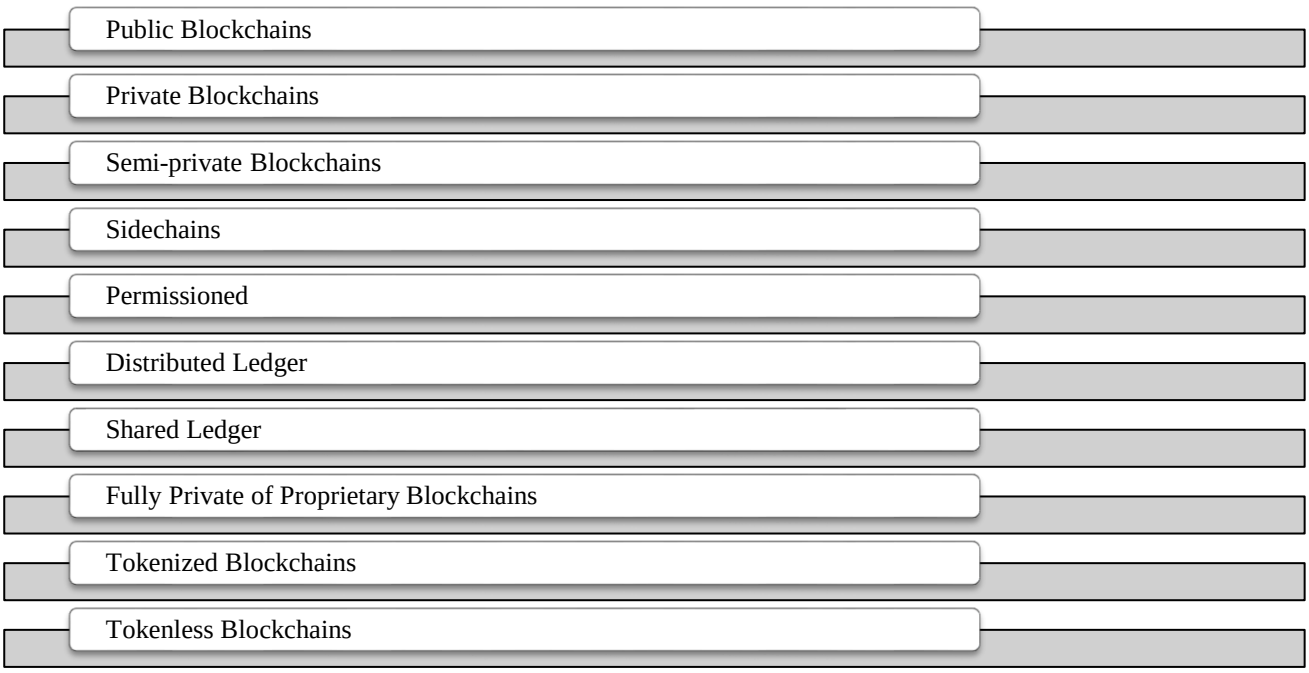

Figure 3.10. Classification of the main types of blockchains by Simanta Shekhar Sarmah

Source: systematized by the author [19]

Blockchain's transparent and decentralized platform has become attractive to companies in many industries that tend to use blockchain for a variety of business purposes. The list of companies that have implemented blockchain technologies in their activities is shown in Table 2.

Banking and payment systems have begun to use the blockchain to make their transactions more efficient and secure. The use of blockchain technologies in financial calculations allows you to efficiently and securely transfer funds using decentralization technology.

Blockchain is also becoming increasingly popular in the healthcare industry, as it is able to restore lost trust between clients and healthcare facilities. With the help of the blockchain, authorization and identification of patients has become easier, and fraud with prescriptions and medical data, as well as the loss of records can now be avoided.

Thanks to the blockchain's ability to efficiently store and verify documents, the legal industry has begun to use the blockchain to securely verify records and documents. Blockchain can significantly reduce litigation and battles by providing an authentic means of verifying and validating legal documents.

Industries such as Insurance, Education, Private transport and Ride sharing, government and public benefits, retail, real estate etc. have started implementing blockchain to reduce costs, to increase transparency and to build trust.

Blockchain technologies have also begun to be used in the public sector, for example during elections. Rigging of election results can be avoided with an effective use of blockchain. Voter registration and validation can be done using blockchain and ensure the legitimacy of votes by creating a publicly available ledger of recorded votes.

Table 3.5. List of Enterprises Implementing Blockchain

Company	Sector	Blockchain Solution
Ford	Auto	Leveraging blockchain technology to enhance the mobility technologies
Toyota	Auto Industry	Planning to use blockchain technology to enhance autonomous driving technology
HSBC	Bank	Using blockchain technology to fully digitize their record keeping and increasing the security of vault system
Anheuser Busch InBev	Beverage	Using blockchain for their beverage supply chain and increasing transparency
Alibaba	e-commerce	Using blockchain technology to track luxury goods in its e-commerce platforms
Tencent	e-commerce/ retail	Solution for verifying invoice authenticity and for ensuring tax compliance
UnitedHealthcare	Healthcare	Using blockchain technology to improve doctors directories to enable accurate insurance claim fillings
Metlife	Healthcare	Using blockchain technology for storing patients medical records for insurance purposes
AIA Group	Insurance	Launched the first of its kind bancassurance for sharing policy data
Prudential	Insurance	Unveils a blockchain powered trading platform for small and medium-sized enterprises
BHP Billiton	Mining	Leveraging blockchain technology for supply chain management
Shell	Oil	Planning to use blockchain for crude oil trading to get rid of corruption
Pfizer	Pharmaceutical	Tracking records and managing the digital inventory of pharmaceutical products
JLL	Real Estate	Exploring blockchain for Spanish commercial real estate valuation
Walmart	Retail	Using blockchain technology to track product movement from farmers to stores
Nestle	Retail	Using blockchain technology in supply management to track baby food products
Baidu	Search giant	Using blockchain to enhance intellectual rights management
Maersk	Shipping	Blockchain system for tracking movement of shipments between ports
UPS	Shipping	Blockchain powered logistics monitoring and management solution
FedEx	Shipping	Working on blockchain solution for settling customer disputes
Samsung	Tech	Intends to use blockchain technology to enhance supply chain management when it comes to electronics shipments
Facebook	Tech	Exploring the use of blockchain to enhance data security and users privacy
Apple	Tech	Patented blockchain technology for time stamping data
Google	Tech	Exploring the use of blockchain technology to enhance cloud service security and for data protection
British Airways	Travel Industry	Implementing blockchain to manage flight data as well as verifying traveler's identity

Source: systematized by the author [46-47]

SWOT-analysis of the practical use of blockchain in companies has shown that this technology has sustainable prospects. Blockchain technology will no doubt continue to evolve, affecting many industries, including government, retail, information technology, travel, healthcare, education, agriculture and entertainment.

One of the ways to improve the use of blockchain technologies should be:

- increasing the confidentiality of operations;
- scaling of chains of blocks;
- establishing compatibility between different blockchain systems;
- strengthening the security of blockchain operations;
- individual approach to the use of boccein technologies.

Based on the scientific research on the practical use of blockchain in various fields SWOT-analysis was performed (Fig. 3.11).

Strengths	**Weaknesses**
- One of the biggest advantages of Blockchain is dissemination which allows a database to be shared without a central body or entity. - Users are empowered to control their information and transaction. - Blockchains provide complete, consistent and up to date data without accuracy. - Since blockchain does not have any central point of failure due to its decentralized network, it can withstand any security attack. - As no central authority is required, users can be assured that a transaction will be executed as protocol commands.	- Blockchains are expensive and resource intensive as every node in the blockchain repeats a task to reach consensus. - In blockchain, users verify a transaction based on certificate authentication, land titles, cryptocurrencies, etc. But there is no way to reverse a transaction even if both the parties involved in the transaction are ready to do so or if the transaction go sour due to some reason. - One of the disadvantage of blockchain is its complexity and complicacy to understand for a general human being. Blockchain is full of complex concepts and processes which is not yet refined so that common man can easily digest and consume the information on how to use it and hence it's not yet ready for mainstream use.
Possibilities	**Threats**
- Blockchains provide transparency and immutability to the transactions as all the transactions cannot be altered or deleted. - Blockchain's peer-to-peer connections help to identify fraud activities in the network and distributed consensus. - By using blockchain, sensitive business data can be protected using end to end encryption. - Users in a blockchain can easily trace the history of any transaction as all the transactions a blockchain are digitally stamped. - Blockchain are resilient to cyber-attacks due to peer-to-peer nature and network would operate even when some of the nodes are offline or under security attack. - Multiple copies of the data can be stored in the blockchain and hence users can avoid storing sensitive data in one place	- A transaction in the blockchain is settled only when all the nodes in the blockchain successfully verifies the transaction. This could be a very slow process as the block inserted needs to be verified to mark the transaction as authentic by all the nodes. - The size of blockchain grows with an addition of a block. A node needs to store the entire history of the blockchain to be a participant in validating transactions, causing the blockchain to grow continuously. - In blockchain, all the transaction related information is available publicly which can become a great liability when distributed ledgers are used in sensitive environments such as dealing with government data or patients medical data. The ledgers need to be altered and access should be limited with proper clearance only.

Figure 3.11. SWOT-analysis of the practical use of blockchain in companies

Source: developed by the author [46-51]

Based on the results of Report to the Nation, fraudsters do not necessarily limit themselves to one method of stealing. According to Report to the Nation, 40% involved more than one of the three primary categories of occupational fraud. As noted, 32% of fraudsters committed both asset misappropriation and corruption schemes as part of their crime, 2% misappropriated assets and committed financial statement fraud, 1% engaged in both corruption and financial statement fraud, and 5% included all three categories in their schemes.

Analysis of the average monthly losses of companies from various types of economic fraud, presented in Fig. 3.12, shows that the biggest losses the company has from the Financial statement fraud.

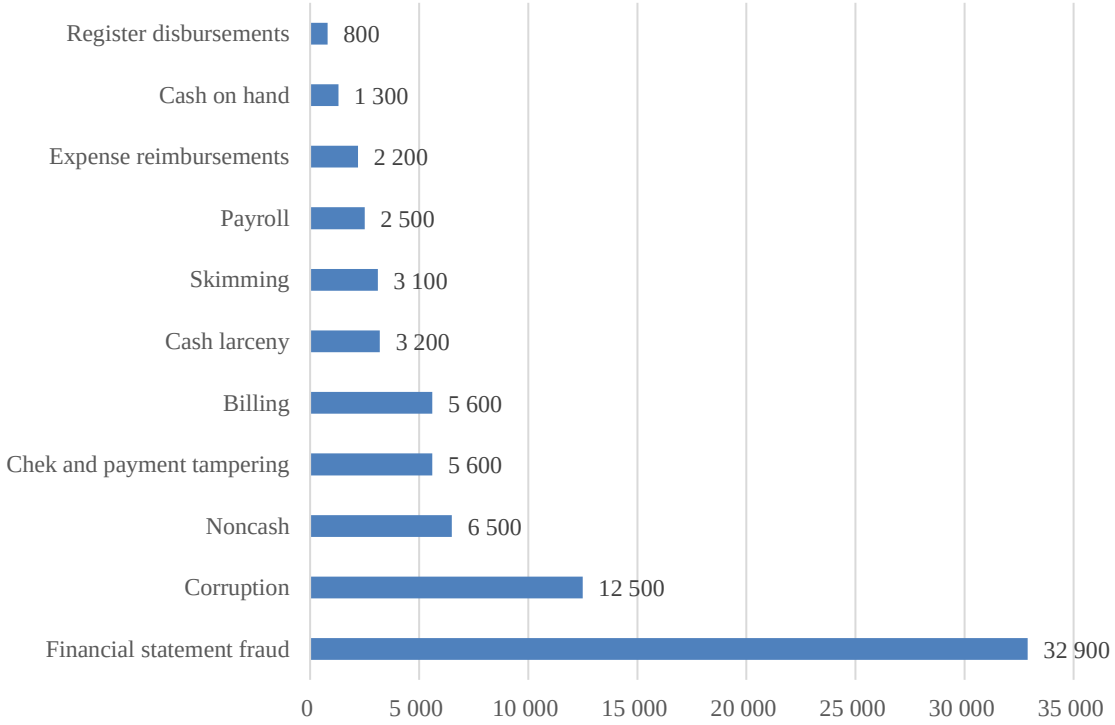

Figure 3.12. The average monthly loss of companies from various types of economic fraud, $

Source: systematized by the author on the basis of Report to the Nation [45]

The average period of fraud, according to Fig. 3.13, is 18 months, indicating that all cases of fraud were not spontaneous. Each case of fraud was preceded by training, which could last from 6 to 12 months.

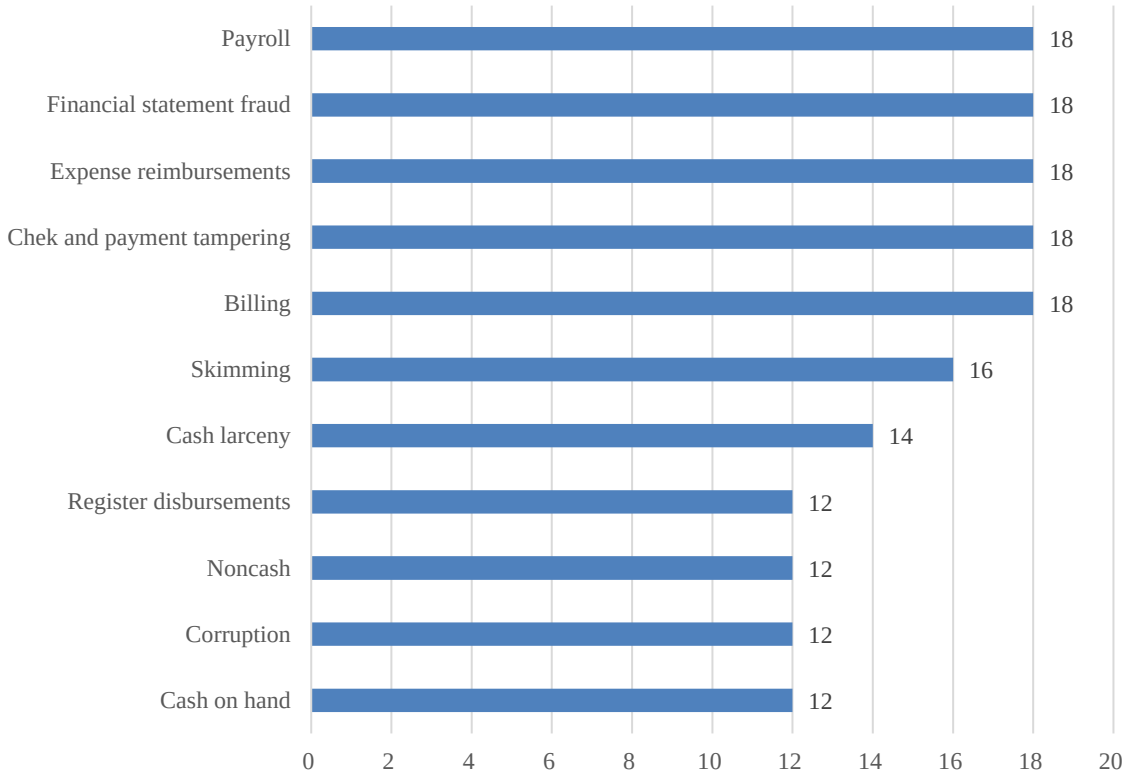

Figure 3.13. The average period from various types of economic fraud, months

Source: systematized by the author on the basis of Report to the Nation [45]

Analyzing various industries and cases of fraud, we found that the most common is corruption, which occurs in more than 40% (Insurance, Retail, Banking and financial services, Education), more than 50% (Health care, Technology, Food service and hospitality, Construction, Information, Transportation and warehousing, Manufacturing) and more than 60% (Energy). We believe that corruption in each of the industries has its own specifics and different types (Table 3.6).

The eight departments listed in Table 3.7 account for 76% of all professional fraud in the report presented in the Report to the Nation. In this table, we have identified the frequency of different types of professional fraud that have occurred in each department. The information obtained can help companies assess the risks of fraud and implement effective anti-fraud tools in these high-risk areas.

Table 3.6. The most common occupational fraud schemes in various industries

Industry	Cases	Billing	Cash larceny	Cash on hand	Check and payment tampering	Corruption	Expense reimbursements	Financial statement fraud	Noncash	Payroll	Register disbursements	Skimming
Banking and financial services	351	10%	11%	14%	14%	46%	8%	11%	11%	4%	2%	10%
Government and public administration	198	21%	8%	7%	9%	57%	12%	8%	16%	16%	3%	8%
Manufacturing	194	26%	5%	9%	7%	59%	10%	12%	23%	10%	4%	8%
Health care	130	20%	6%	8%	8%	50%	11%	9%	18%	12%	2%	9%
Energy	97	24%	9%	6%	8%	64%	16%	8%	13%	6%	3%	2%
Retail	91	19%	10%	9%	9%	43%	7%	4%	24%	5%	7%	14%
Insurance	88	15%	9%	8%	10%	40%	9%	5%	8%	10%	2%	11%
Technology	84	21%	6%	10%	6%	54%	14%	8%	30%	5%	1%	1%
Transportation and warehousing	82	20%	9%	15%	4%	59%	11%	7%	22%	9%	4%	11%
Construction	78	24%	8%	10%	14%	56%	17%	18%	24%	24%	3%	9%
Education	69	26%	9%	12%	12%	49%	12%	12%	19%	14%	4%	12%
Information	60	15%	5%	5%	8%	58%	12%	12%	33%	7%	2%	7%
Food service and hospitality	52	19%	10%	21%	17%	54%	13%	13%	29%	19%	10%	17%

Source: systematized by the author on the basis of Report to the Nation [45]

Table 3.7. The most common occupational fraud schemes in high-risk departments

Department	Cases	Billing	Cash larceny	Cash on hand	Check and payment tampering	Corruption	Expense reimbursements	Financial statement fraud	Noncash	Payroll	Register disbursements	Skimming
Operations	273	16%	7%	8%	11%	48%	9%	6%	16%	8%	1%	6%
Accounting	230	24%	15%	13%	29%	33%	10%	10%	7%	16%	3%	19%
Executive/upper management	206	31%	9%	10%	12%	65%	18%	22%	21%	13%	2%	12%
Sales	203	11%	6%	7%	2%	51%	8%	6%	18%	4%	2%	11%
Customer service	140	8%	10%	16%	11%	44%	6%	7%	17%	6%	3%	10%
Administrative support	131	23%	8%	15%	15%	37%	16%	5%	12%	12%	5%	10%
Purchasing	131	27%	1%	4%	2%	82%	5%	2%	14%	3%	0%	2%
Finance	95	26%	7%	11%	12%	48%	20%	14%	12%	7%	3%	12%

Source: systematized by the author on the basis of Report to the Nation [45]

It was found that corruption is also the most common in each department. In the Operations Department, the second most common types of fraud are Billing (16%) and Noncash (16%); in the Accounting department - Check and payment tampering (29%); in the Executive / upper management department - Billing (31%); in the Sales Department - Noncash (18%); in the Customer service department - Noncash (17%); in the Administrative Support Department - Billing (23%); in the Purchasing Department - Billing (27%); in the Department of Finance - Billing (26%).

The most common occupational fraud schemes by region are presented in Table 3.8.

Table 3.8. The most common occupational fraud schemes by region

Schemes	Latin America and Caribbean	Eastern Europe and Western/Central Asia	Middle East and North Africa	Southern Asia	Sub-Saharan Africa	United States and Canada	Western Europe
Corruption	57%	59%	59%	71%	62%	37%	44%
Billing	20%	13%	16%	18%	19%	24%	19%
Noncash	17%	15%	17%	15%	19%	18%	24%
Financial statement fraud	11%	17%	8%	15%	9%	8%	10%
Cash on hand	11%	9%	7%	12%	8%	11%	13%
Cash larceny	6%	5%	7%	11%	5%	10%	9%
Expense reimbursements	15%	2%	9%	10%	7%	17%	10%
Skimming	9%	7%	9%	10%	7%	13%	7%
Check and payment tampering	9%	5%	6%	5%	10%	15%	9%
Payroll	11%	4%	9%	4%	5%	16%	8%
Register disbursements	2%	3%	4%	2%	1%	4%	3%

Source: systematized by the author on the basis of Report to the Nation [45]

Table 3.8 shows that the most common occupational fraud schemes in all countries are corruption, with Southern Asia having the highest levels. Among other types of occupational fraud schemes, Billing can be found most often in Latin America and Caribbean region, Noncash - in Western Europe region, Financial statement fraud - in Eastern Europe and Western / Central / Asia region, Cash on hand - Western Europe region, Cash larceny - in Southern Asia region, Expense reimbursements - in United States and Canada region, Skimming - in United States and Canada region, Check and payment tampering - in United States and Canada region, Payroll - in United States and Canada region, Register disbursements - in United States and Canada region and Middle East and North Africa region.

It is very important to identify the tools that should be used to identify occupational fraud. The main tools of occupational fraud are initially detected by region are presented in Table 3.9.

Table 3.9. The main tools of occupational fraud are initially detected by region

Control	Latin America and Caribbean	Eastern Europe and Western/Central Asia	Middle East and North Africa	Southern Asia	Sub-Saharan Africa	United States and Canada	Western Europe
Tip	58%	41%	41%	51%	48%	32%	41%
Internal audit	11%	23%	24%	16%	10%	18%	16%
Management review	10%	9%	9%	7%	11%	16%	10%
Automated transaction/data monitoring	3%	5%	4%	1%	4%	5%	9%
By accident	5%	6%	1%	5%	5%	7%	6%
Document examination	5%	1%	4%	9%	6%	5%	6%
External audit	2%	4%	5%	3%	4%	4%	5%
Account reconciliation	3%	4%	7%	5%	6%	5%	2%
Surveillance/monitoring	1%	2%	-	1%	2%	5%	2%
Confession	-	-	1%	-	1%	1%	1%
Notification by law enforcement	1%	2%	2%	1%	2%	2%	1%
Other	-	1%	1^	1%	1%	1%	1%

Source: systematized by the author on the basis of Report to the Nation [45]

According to the study, tip, internal audit and management review are used to identify company fraud in all regions.

Every company understands that it is not enough to detect fraud, but it is very necessary to periodically use anti-fraud controls. The most common anti-fraud controls are presented in Figure 3.14.

The most common anti-fraud controls on the results of the Nations Report are the External audit of financial statements (82%) and Code of conduct (82%). The least effective anti-fraud controls are Job rotation / mandatory vacation (25%) and Rewards for whistleblowers (15%).

The most common anti-fraud controls by region are presented in Table 3.10.

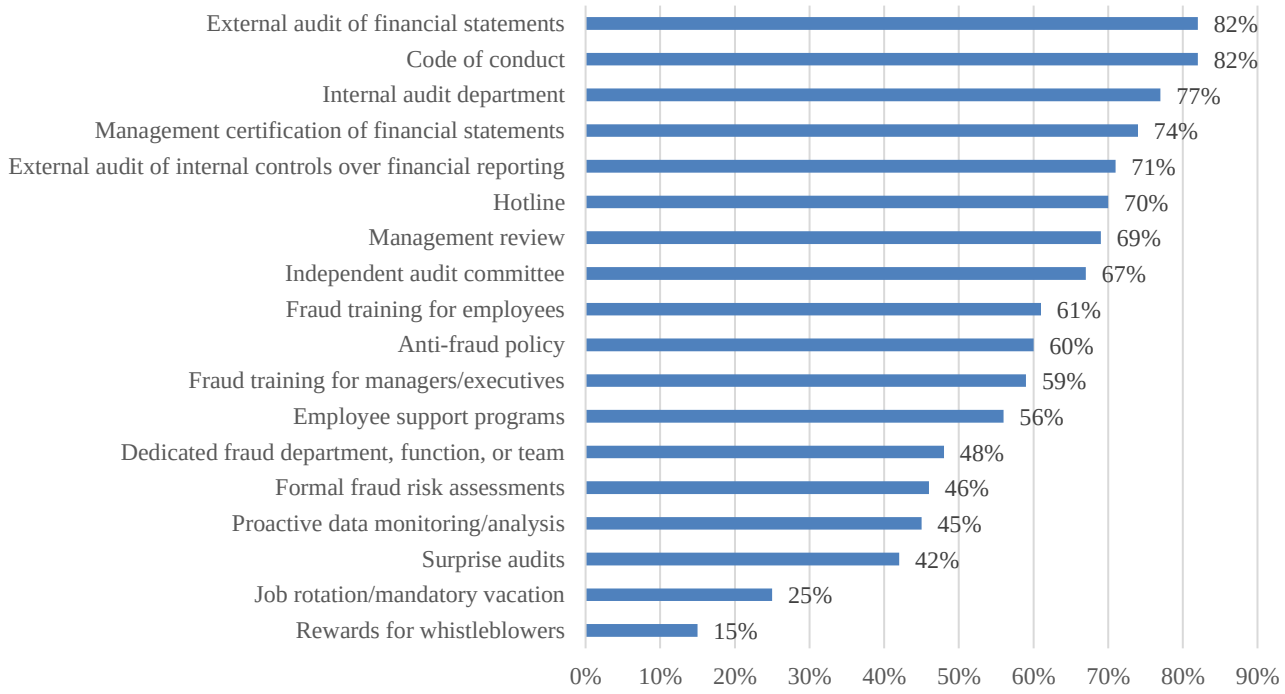

Figure 3.14. The most common anti-fraud controls

Source: systematized by the author on the basis of Report to the Nation [45]

Table 3.10. The most common anti-fraud controls by region

Control	Latin America and Caribbean	Eastern Europe and Western/Central Asia	Middle East and North Africa	Southern Asia	Sub-Saharan Africa	United States and Canada	Western Europe
Code of conduct	84%	83%	82%	88%	89%	74%	84%
Internal audit department	81%	81%	86%	85%	87%	66%	74%
External audit of financial statements	76%	83%	89%	91%	87%	72%	90%
Management review	70%	71%	71%	72%	72%	63%	72%
Management certification of financial statements	69%	68%	79%	84%	83%	65%	78%
Independent audit committee	69%	69%	71%	76%	74%	56%	65%
Hotline	67%	75%	68%	72%	76%	63%	68%
External audit of internal controls over financial reporting	65%	66%	70%	85%	76%	63%	77%
Fraud training for managers/executives	52%	60%	54%	66%	62%	55%	58%
Anti-fraud policy	52%	52%	60%	63%	69%	51%	56%
Fraud training for employees	52%	62%	58%	63%	67%	55%	59%
Employee support programs	50%	21%	32%	45%	58%	66%	51%
Dedicated fraud department, function, or team	35%	55%	44%	53%	56%	41%	47%
Formal fraud risk assessments	32%	37%	43%	45%	53%	42%	52%
Proactive data monitoring/analysis	30%	40%	43%	42%	47%	43%	48%
Surprise audits	28%	46%	48%	48%	47%	35%	40%
Job rotation/mandatory vacation	21%	21%	24%	33%	30%	20%	25%
Rewards for whistleblowers	5%	12%	14%	24%	18%	14%	7%

Source: systematized by the author on the basis of Report to the Nation [45]

Table 3.10 shows that in most countries in the region as anti-fraud controls use Code of Conduct - Sub-Saharan Africa (89%), Latin America and Caribbean (84%), Eastern Europe and Western / Central Asia (83%) , United States and Canada (74%), as well as External audit of financial statements - Southern Asia (91%), Western Europe (90%) and Middle East and North Africa (89%).

It should be noted that a large number of companies use proactive data monitoring/analysis (from 30% to 48%), an integral part of which is blockchain technology.

We believe that the creation and use of blockchain technologies in financial transactions is a necessary condition to protect companies from various types of fraud.

To solve this problem, we propose an algorithm for creating and using blockchain technologies at the enterprise (Figure 3.15).

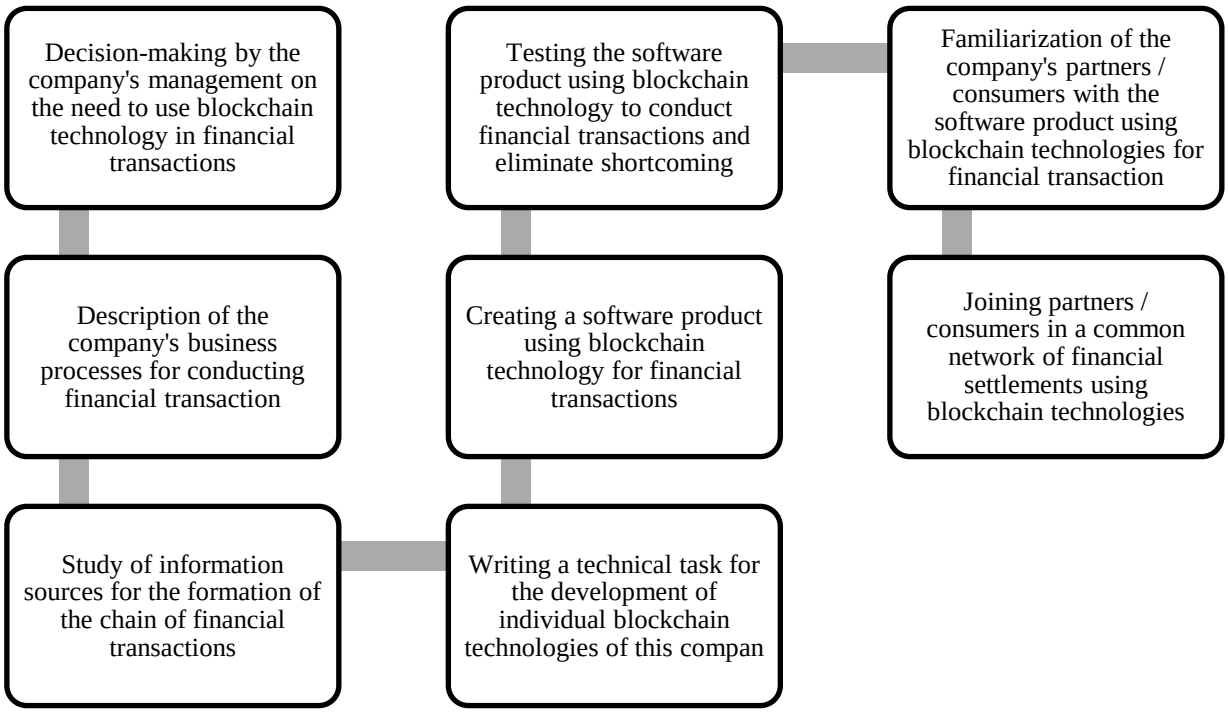

Figure 3.15. The main stages of creation and use of blockchain technologies for financial transactions of the company

Source: developed by the author

To substantiate the need for the introduction of blockchain technologies at the company level, in the context of ensuring internal control over financial transactions between different countries, a SWOT analysis was conducted (Fig. 3.16).

Strengths	Weaknesses
- the ability to track changes in financial documents; - minimization of delays in the preparation of financial documents; - reduction of administrative efforts on internal control of financial transactions; - improving the business reputation of enterprises that use blockchain technologies; - easier fraud detection, etc.	- immature mechanism and little experience in the application of blockchain technologies in Ukraine; - the need to transform the system of interaction between subjects of financial transactions; - the need to develop regulatory support for the use of blockchain technologies in Ukraine
Possibilities	**Threats**
- compliance with general trends in the development of financial relations; - improving the efficiency of fraud detection activities; - transparency of information and computer confirmation of transactions performed	- lack of a universal approach in determining the criteria for cross-border exchange of financial information to be used by different stakeholders; - blockchain technology must be adopted by all stakeholders to ensure that it works properly

Figure 3.16. SWOT-analysis of the implementation of blockchain technologies for financial transactions of companies between different countries

Source: developed by the author

In Figure 3.16 shows the results of a SWOT analysis of the implementation of blockchain technologies at the company level for financial transactions of companies between different countries. The most significant main advantages are: the ability to track changes in financial documents; minimization of delays in the preparation of financial documents; reduction of administrative efforts on internal control of financial transactions; improving the business reputation of companies that use blockchain technology; easier to detect fraud.

At the same time, among the threats are: the lack of a universal approach in determining the criteria for cross-border exchange of financial information to be used by different stakeholders; blockchain technology must be accepted by all stakeholders for it to work properly.

So, although the blockchain is still under development, it can dramatically change the way we do business, especially in the financial transactions of companies between different countries and can be used to ensure the economic security of enterprises.

According to the results of the study, the following conclusions can be drawn:

The relationship between the stages of evolution and Tiers of Blockchain has been established: 2008-2013 (Blockchain 1.0); 2013-2015 (Blockchain 2.0); 2015-2018 (Blockchain 3.0); From 2018 to now (Generation X). The main types of blockchain (public blockchains; private blockchains; semi-private blockchains; sidechains; permissioned; distributed ledger; shared ledger; fully private of proprietary blockchains; tokenized blockchains; tokenless blockchains) are systematized.

Based on the Report to the Nation prepared by the Association of Certified Fraud Examiners (ACFE), the average monthly loss of companies from various types of economic fraud and the period from various types of economic fraud were analyzed. It is established that the largest monthly losses of the company are from the Financial statement fraud, which lasts an average of 18 months. The frequency of cases of different types of fraud depending on the industry is analyzed. It is established that the most common companies in every industry are corruption.

The 8 most risky departments in which various types of fraud occur have been identified. It was found that corruption is also the most common in each department. Thus, in the Operations Department, the second most common types of fraud are Billing (16%) and Noncash (16%); in the Accounting department - Check and payment tampering (29%); in the Executive / upper management department - Billing (31%); in the Sales Department - Noncash (18%); in the Customer service department - Noncash (17%); in the Administrative Support Department - Billing (23%); in the Purchasing - Billing department (27%); in the Department of Finance - - Billing (26%).

One of the ways to improve the use of blockchain technologies should be: increasing the confidentiality of operations; scaling of chains of blocks; establishing compatibility between different blockchain systems; strengthening the security of blockchain operations; individual approach to the use of blockchain technology. The main stages of creation and use of blockchain technologies for financial transactions

of the company are offered, which will allow to carry out anti-fraud controls more effectively.

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Monograph

Published by: OÜ Scientific Center of Innovative Research, Viru 8-33, Pussi, Estonia
Number of copies: 300
First printing: June 10, 2023
Distributed worldwide by OÜ Scientific Center of Innovative Research - office@scnchub.com
Full text available online at https://scnchub.com.
DOI: 10.36690/DIFTDE